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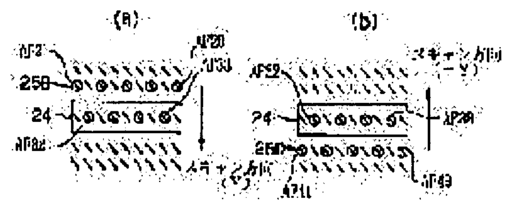
(54) PLANE POSITION SETTING DEVICE

(57)Abstract:
PURPOSE: To align an exposure face of a photosensitive board with an image face of a projection optical system with high precision in a projection aligner using a slit-scanning exposure system.
CONSTITUTION: When a wafer is scanned being exposed in a Y-direction against a slitted exposing field 24, the leveling and focusing for the wafer are controlled based on the information on the focus positions which are obtained from the sample points AF21 to AF29 of a second row 25B on this side against the scanning direction and from the sample points AF 32 to AF38 in the field 24. On the other hand, when the wafer is scanned being exposed in a -Y-direction, the leveling and focusing are controlled based on the information on the focus positions which are obtained from the sample points AF41 to AF49 of a fourth row 25D on this side against the scanning direction and from the sample points AF32 to AF38 in the field 24.



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CLAIMS

[Claim(s)]
[Claim 1] Lighting optical system which illuminates the lighting field of a predetermined configuration with exposure light. The mask side stage which scans the mask with which the pattern for exposure was formed to the aforementioned lighting field, the projection optical system which projects the pattern of the aforementioned mask in the aforementioned lighting field on a sensitization substrate, and the substrate side stage which scans the aforementioned sensitization substrate synchronizing with the aforementioned mask. A multipoint measurement means to be field positioning equipment equipped with the above, and to measure the height of a direction parallel to the optical axis of the aforementioned projection optical system of the aforementioned sensitization substrate in two or more measure points including two or more points of the direction which crosses in the direction in which the aforementioned sensitization substrate is scanned, respectively, An operation means to ask for the difference of the tilt angle between the exposure side of the aforementioned sensitization substrate, and the image surface of the aforementioned projection optical system from the measurement result of this multipoint measurement means, It is prepared in the aforementioned substrate side stage, and is based on the difference of the aforementioned tilt angle called for by the aforementioned operation means. A speed of response in case it has the inclination setting stage which sets up the tilt angle of the direction which intersects perpendicularly in the tilt angle of the direction of the aforementioned scan of the aforementioned sensitization substrate, and the direction of the aforementioned scan and this inclination setting stage sets up the tilt angle of the direction of the aforementioned scan of the aforementioned sensitization substrate, It is characterized by making the speed of responses when setting up the tilt angle of the direction which intersects perpendicularly towards the aforementioned scan differ.
[Claim 2] The aforementioned multipoint measurement means is field positioning equipment according to claim 1 characterized by sampling the height of the aforementioned sensitization substrate in the measure point of the aforementioned plurality in the datum reference of the aforementioned substrate side stage when the aforementioned sensitization substrate is scanned through the aforementioned substrate side stage.
[Claim 3] the aforementioned multipoint measurement means -- the lighting field and the aforementioned projection optical system of the aforementioned predetermined configuration -- being related -- two or more points in a conjugate exposure field, and the above -- the field positioning equipment according to claim 1 or 2 characterized by to measure the height of the aforementioned sensitization substrate, respectively in two or more measure points which consist of two or more points in the field of this side at the time of the aforementioned sensitization substrate being scanned to the inside of a conjugate exposure field
[Claim 4] The aforementioned multipoint measurement means is field positioning equipment according to claim 1 characterized by changing the position of two or more aforementioned measure points to one shot field of the aforementioned sensitization substrate one by one in the process which exposes the pattern of the aforementioned mask one by one.
[Claim 5] The lighting optical system which is characterized by providing the following and which illuminates the lighting field of a predetermined configuration with exposure light, The mask side stage which scans the mask with which the pattern for exposure was formed to the aforementioned lighting field, The projection optical system which projects the pattern of the aforementioned mask in the aforementioned lighting field on a sensitization substrate, It is prepared in the aligner which has the substrate side stage which scans the aforementioned sensitization substrate synchronizing with the aforementioned mask. It is field positioning equipment for doubling the height of the exposure side of the aforementioned sensitization substrate with the image surface of the aforementioned projection optical system. The predetermined measure point in the measurement field which consists of a field of this side at the time of the aforementioned sensitization substrate being scanned to a conjugate exposure field and this exposure field about the lighting field and the aforementioned projection optical system of the aforementioned predetermined configuration. A

height measurement means to measure the height of a direction parallel to the optical axis of the aforementioned projection optical system of the aforementioned sensitization substrate. An operation means to ask for the difference of the average height of the exposure side of the aforementioned sensitization substrate, and the height of the image surface of the aforementioned projection optical system based on the maximum and the minimum value of two or more height measurement results obtained by the aforementioned height measurement means when the aforementioned sensitization substrate is scanned. The height setting stage which sets up the height of the aforementioned sensitization substrate based on the difference of the aforementioned height which was prepared in the aforementioned substrate side stage and found by the aforementioned operation means.

[Translation done.]

* NOTICES *

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industry-like field of the invention] this invention is applied to the autofocus mechanism or auto leveling mechanism of a projection aligner of for example, a slit scan exposure method, and relates to suitable field positioning equipment.
[0002]
[Description of the Prior Art] In case a semiconductor device, a liquid crystal display element, or the thin film magnetic head is manufactured at a photolithography process, the projection aligner which imprints the pattern of a photo mask or a reticle (it is hereafter named a "reticle" generically) on the substrates (a wafer, glass plate, etc.) applied to sensitization material is used. As a conventional projection aligner, each shot field of a wafer was moved into the exposure field of a projection optical system one by one, and many reduction projection type aligners (stepper) of the step-and-repeat method of exposing the pattern image of a reticle one by one to each shot field were used.
[0003] Drawing 20 shows the conventional stepper's important section, in this drawing 20 , it is the basis of the exposure light EL from the lighting optical system by which the illustration ellipsis was carried out, and projection exposure of the image of the pattern on a reticle 51 is carried out to each shot field on the wafer 53 with which the photoresist was applied through the projection optical system 52. A wafer 53 is held on Z leveling stage 54, and Z leveling stage 54 is laid on wafer side X-Y stage 55. Wafer side X-Y stage 55 positions a wafer 53 within a flat surface (XY flat surface) perpendicular to the optical axis AX1 of a projection optical system 52, and sets Z leveling stage 54 as the state where the focal position (position of a direction parallel to an optical axis AX1) of the exposure side of a wafer 53 and the tilt angle of the exposure side were specified.
[0004] Moreover, the move mirror 56 is being fixed on Z leveling stage 54. The laser beam from the external laser interferometer 57 is reflected in the move mirror 56, the X coordinate and Y coordinate of wafer side X-Y stage 55 are always detected by the laser interferometer 57, and these X coordinates and the Y coordinate are supplied to the main-control system 58. The main-control system 58 exposes the pattern image of a reticle 51 one by one to each shot field on a wafer 53 by the step-and-repeat method by controlling operation of wafer side X-Y stage 55 and Z leveling stage 54 through a driving gear 59.
[0005] Under the present circumstances, although the pattern formation side on a reticle 51 (reticle side) and the exposure side of a wafer 53 need to be conjugate about the projection optical system 52, a projection scale factor is high, and since the depth of focus is large, a reticle side is seldom changed. Then, generally, by the focal position detection system of an oblique-incidence type multipoint, it detected whether the exposure side of a wafer 53 would have agreed within the limits of the depth of focus in the image surface of a projection optical system 52 (does it focus or not?), and the focal position of the exposure side of a wafer 53 and control of a tilt angle were performed conventionally.
[0006] In the focal position detection system of the conventional multipoint, the lighting light which does not expose the photoresist on a wafer 53 unlike the exposure light EL is drawn through the optical fiber bundle 60 from the lighting light source by which the illustration ellipsis was carried out. The lighting light injected from the optical fiber bundle 60 illuminates the pattern formation board 62 through a condenser lens 61. The lighting light which penetrated the pattern formation board 62 is projected on the exposure side of a wafer 53 through a lens 63, a mirror 64, and the irradiation objective lens 65, and projection image formation of the image of the pattern on the pattern formation board 62 is aslant carried out to the exposure side of a wafer 53 to an optical axis AX1. The lighting light reflected with the wafer 53 is re-projected on an electric eye 69 in a light-receiving side through the condensing objective lens 66, the hand-of-cut diaphragm 67, and the image formation lens 68, and re-image formation of the image of the pattern on the pattern formation board 62 is carried out to the light-receiving side of an electric eye 69. In this case, the main-control system 58 gives vibration like the after-mentioned to the hand-of-cut diaphragm 67 through excitation equipment 70,

the detecting signal from many photo detectors of an electric eye 69 is supplied to a signal processor 71, and a signal processor 71 supplies the focal signal of a large number which carried out the synchronous detection of each detecting signal, and obtained it by the driving signal of excitation equipment 70 to the main-control system 58.

[0007] As drawing 21 (b) shows the opening pattern formed on the pattern formation board 62 and shows it to this drawing 21 (b), on the pattern formation board 62, the opening pattern 72-1 to 72-9 of the shape of nine slit is formed in the shape of a cross joint. Since those opening patterns 72-1 to 72-9 are irradiated from the direction which crosses at 45 degrees to the X-axis and a Y-axis to the exposure side of a wafer 53, each projection images AF1-AF9 of these openings pattern 72-1 to 72-9 in the exposure field of the projection optical system 52 on the exposure side of a wafer 53 become arrangement as shown in drawing 21 (a). In drawing 21 (a), it is inscribed in the circular lighting visual field of a projection optical system 52, the maximum exposure field 74 is formed, and the projection image of a slit-like opening pattern is projected on the center section in the maximum exposure field 74, and the measure points AF1-AF9 on the two diagonal lines, respectively.

[0008] As drawing 21 (c) shows the situation of the light-receiving side of an electric eye 69 and shows it to this drawing 21 (c), nine photo detectors 75-1 to 75-9 are arranged in the light-receiving side of an electric eye 69 at a cross-joint type, and the gobo (illustration ellipsis) which has slit-like opening is arranged on each photo detector 75-1 to 75-9. And re-image formation of the image on each measure points AF [AF1-] 9 of drawing 21 (a) is carried out on each photo detector 75-1 to 75-9 of an electric eye 69, respectively. In this case, the lighting light reflected in respect of exposure of the wafer 53 of drawing 20 (wafer side) Since it is reflected by the hand-of-cut diaphragm 67 which vibrates around a shaft almost perpendicular to the space of drawing 20 (rotational vibration) while existing in the pupil position of the condensing objective lens 66, As shown in drawing 21 (c), on an electric eye 69, it vibrates in the direction of RD whose position of the projection image by which re-image formation is carried out on each photo-detector 75-1 - 75-9 is the cross direction of slit-like opening.

[0009] Moreover, since the image of opening of the shape of a slit on each measure points AF [AF1-] 9 of drawing 21 (a) is aslant projected to the optical axis of a projection optical system 52, if the focal position of the exposure side of a wafer 53 changes, the re-image formation position on the electric eye 69 of these projection images will change in the direction of RD. Therefore, nine focal signals corresponding to the focal position of measure points AF1-AF9 are acquired within a signal processor 71, respectively by carrying out the synchronous detection of the detecting signal of each photo detector 75-1 to 75-9 by the excitation signal of the hand-of-cut diaphragm 67, respectively. And from the focal position of nine pieces, the tilt angle of the average field of the exposure field 74 and the focal position of the average field are called for, the main-control system 58 is supplied, and the main-control system 58 sets the focal position and tilt angle (leveling angle) of the shot field concerned of a wafer 53 as a predetermined value through a driving gear 59 and Z leveling stage 54. Thus, in the stepper, in each shot field of a wafer 53, a focal position and a tilt angle are in the state where it doubled with the image surface of a projection optical system 52, and the pattern image of a reticle 51 was exposed, respectively.

[0010]

[Problem(s) to be Solved by the Invention] Since the pattern has turned minutely in the semiconductor device etc. in recent years, heightening the resolution of a projection optical system is called for. Although there is technique, such as short-wavelength-izing of the wavelength of exposure light or increase of the numerical aperture of a projection optical system, among the technique for heightening resolution, if it is going to secure the exposure field of the same grade as the conventional example even when using which technique, it will become difficult to maintain image formation performances (distortion, curvature of field, etc.) for a predetermined precision all over the exposure field. Then, the so-called projection aligner of a slit scan exposure method is improved now.

[0011] In the projection aligner of this slit scan exposure method, the pattern of the reticle is exposed on a wafer, synchronizing relatively and scanning a reticle and a wafer to the shape of a rectangle, and the lighting field (henceforth a "slit-like lighting field") of circular **. Therefore, the image was equalized in the lighting field of the shape of an aforementioned slit, and the conjugate field, and there was an advantage that distortion precision improved.

[0012] Although the mainstream of the size of the conventional reticle was 6 inch size and the mainstream of the projection scale factor of a projection optical system was 1/5 time, the size of the reticle in a basis 1/5 time the scale factor of this has stopped moreover, 6 inch size being of use with large area-ization of circuit patterns, such as a semiconductor device. Therefore, it is necessary to design the projection aligner which changed the projection scale factor of a projection optical system 1/4 time. And the slit scan exposure method which can make small the diameter of the exposure field of a projection optical system to large-area-izing of such a transferred pattern is advantageous also in a cost side.

[0013] In the projection aligner of this slit scan exposure method, though the focal multipoint type position detection

system used by the conventional stepper is applied as it is and the focal position and tilt angle of an exposure side on a wafer are measured, since the wafer was scanned in the predetermined direction, there was un-arranging [that it was difficult to double an actual exposure side with the image surface of a projection optical system]. That is, probability of the technique for doubling the focal position and tilt angle of a wafer with the image surface of a projection optical system in the projection aligner of a slit scan exposure method conventionally was not carried out.
[0014] this invention aims at offering the field positioning equipment which can be used in the projection aligner of a slit scan exposure method in order to double the exposure side of a sensitization substrate with high precision to the image surface of a projection optical system in view of this point.
[0015]
[Means for Solving the Problem] The lighting optical system with which the 1st field positioning equipment of this invention illuminates the lighting field of a predetermined configuration with exposure light, The mask side stage which scans the mask (12) with which the pattern for exposure was formed to the lighting field (10), The projection optical system which projects the pattern of the mask in the lighting field (12) on a sensitization substrate (5) (8), It is prepared in the aligner which has the substrate side stage (2) which scans a sensitization substrate (5) synchronizing with a mask (12). It is field positioning equipment for doubling the exposure side of a sensitization substrate (5) in parallel with the image surface of a projection optical system (8). A multipoint measurement means to measure the height of a direction parallel to the optical axis of the projection optical system (8) of a sensitization substrate (5) in two or more measure points (AF11-AF59) including two or more points of the direction which crosses in the direction in which a sensitization substrate (5) is scanned, respectively (62A, 69A), It has an operation means (71A) to ask for the difference of the tilt angle between the exposure side of a sensitization substrate (5), and the image surface of a projection optical system (8) from the measurement result of this multipoint measurement means.
[0016] Furthermore, this invention is prepared in a substrate side stage (2), and it is based on the difference of the tilt angle called for by the operation means (71A). As it has the inclination setting stage (4) which sets up the tilt angle of the direction (the direction of X) which intersects perpendicularly in the tilt angle of the direction (the direction of Y) of the scan of a sensitization substrate (5), and the direction of the scan, for example, is shown in drawing 5 An inclination setting stage (4) is tilt-angle thetaY of the direction (the direction of Y) of the scan of a sensitization substrate (5). Tilt-angle thetaX of the direction (the direction of X) which intersects perpendicularly in the speed of response and the direction of a scan of [when setting up] The speed of responses when setting up are made to differ.
[0017] In this case, the multipoint measurement means may sample the height of the sensitization substrate (5) in the measure point of these plurality in the datum reference of a substrate side stage (2), when the sensitization substrate (5) is scanned through the substrate side stage (2). Moreover, the multipoint measurement means may measure the height of a sensitization substrate (5) in two or more measure points which consist of two or more points in the field of this side at the time of a sensitization substrate (5) being scanned to the inside of two or more points in a conjugate exposure field (24), and the conjugate exposure field of those about the lighting field and projection optical system (8) of the predetermined configuration, respectively.
[0018] Moreover, as for the multipoint measurement means, it is desirable to change the position of the measure point of these plurality to one shot field of a sensitization substrate (5) one by one in the process which exposes the pattern of a mask (12) one by one. Moreover, the 2nd field positioning equipment by this invention The lighting optical system which illuminates the lighting field of a predetermined configuration with exposure light, and the mask side stage which scans the mask (12) in which the pattern for exposure was formed to the lighting field (10), The projection optical system which projects the pattern of the mask in the lighting field (12) on a sensitization substrate (5) (8), It is prepared in the aligner which has the substrate side stage (2) which scans a sensitization substrate (5) synchronizing with a mask (12). It is field positioning equipment for doubling the height of the exposure side of a sensitization substrate (5) with the image surface of a projection optical system (8). In the predetermined measure point in the measurement field which consists of a field of this side at the time of a sensitization substrate (5) being scanned to a conjugate exposure field (24) and this exposure field about the lighting field and projection optical system (8) of the predetermined configuration A height measurement means to measure the height of a direction parallel to the optical axis of the projection optical system (8) of a sensitization substrate (5) (62A, 69A), The inside of two or more height measurement results obtained by the height measurement means when a sensitization substrate (5) is scanned, An operation means to ask for the difference of the average height of the exposure side of a sensitization substrate (5), and the height of the image surface of a projection optical system (8) based on maximum and the minimum value (71A), It is prepared in a substrate side stage (2), and has the height setting stage (4) which sets up the height of a sensitization substrate (5) based on the difference of the height found by the operation means (71A).
[0019]
[Function] In the 1st field positioning equipment of this this invention, in case a mask (12) and a sensitization substrate

(5) are scanned synchronously and the pattern image of a mask (12) is exposed on a sensitization substrate (5), the height of a sensitization substrate (5) is measured in two or more measure points including the measure point before the direction of the scan using the multipoint measurement means. And it asks for the tilt angle of a sensitization substrate (5) by acquiring multiple-times height information along the direction of a scan in the measure point of these plurality, respectively. Then, in case the pattern image of a mask (12) is exposed to the field to which the tilt angle was called for such, the tilt angle of the field is set up based on the tilt angle for which it asked beforehand. Thereby, the exposure side of a sensitization substrate (5) is set up in parallel with the image surface of a projection optical system (8) also by the slit scan exposure method.

[0020] Moreover, in this invention, in case such leveling is performed, the speed of response of leveling of the direction of a scan differs from the speed of response of the direction leveling of a non-scan. In order to explain per [by this] operation effect, focusing at the time of slit scan exposure and the error factor of leveling are explained. The following errors can be considered by the aligner of a slit scan exposure method.

** A focal offset error and an oscillating error focus offset error are differences of the focal position of the average field of an exposure side, and the image surface of a projection optical system, and an oscillating error is an error resulting from vibration of the direction of a focus of the substrate side stage at the time of carrying out scanning exposure etc. It divides, when carrying out package exposure like a stepper as what performs only autofocus control, and when exposing by the slit scan exposure method, and this is explained more to a detail.

[0021] Drawing 14 (a) shows the case where drawing 14 (b) is exposed by the slit scan exposure method, when carrying out package exposure. although the average field 34 of exposure side 5a of a sensitization substrate has agreed in the image surface of a projection optical system in drawing 14 (a) -- the average field 34 where the focal position of positions Ya, Yb, and Yc is fixed respectively -- receiving -deltaZ -- 1 and 0 differ only from deltaZ2 Therefore, the focal offset errors in positions Ya and Yb are -deltaZ1 and deltaZ2, respectively.

[0022] On the other hand, in the case of drawing 14 (b), the image surface of a projection optical system doubles one by one to the direction of a scan in a series of partial average sides 35A, 35B, and 35C on exposure side 5a, and .... Therefore, the focal offset error in each positions Ya, Yb, and Yc is set to 0 by the equalization effect, respectively. However, since a focal position moves between height deltaZB(s) from average side 35B to average side 35D to forming the image on a position Yb, the image on a position Yb will turn into an image with which only delta ZB had dispersion in the direction of a focus. Similarly, the image on a position Ya and Yc turns into an image with which only delta ZA and delta ZB had dispersion in the direction of a focus, respectively.

[0023] That is, in a slit scan exposure method, although a focal offset error is set to about 0 to the irregularity of the sensitization substrate side below a certain constant frequency, the wavelength variation of the short period of rolling of a substrate side stage, pitching, vibration of the direction of a focus (Z shaft orientations), the error component by an autofocus mechanism and an auto leveling mechanism following a low frequency air fluctuation error, and exposure light (KrF excimer laser light etc.) etc. produces a new error (oscillating error).

[0024] ** Although it is a typical example of a focal following error, an air fluctuation error, and the oscillating errors that made reference by stage oscillating error ** and these are dependent on the response frequency of an autofocus mechanism and an auto leveling mechanism, it can classify into the following errors further.

(1) (2), such as a RF stage oscillating error, a wavelength variation error of the short period of exposure light (KrF excimer laser light etc.), etc. uncontrollable by the control system (3), such as a low frequency air fluctuation error which a substrate side stage follows in an air fluctuation error Measurement error it is without error for a focal error since a substrate side stage does not follow, although contained in the measurement result of a focal position detection system or a tilt-angle detection system.

[0025] ** a field unit with the two-dimensional exposure field according [the error of ****** by unevenness of the exposure side of a sensitization substrate] to a projection optical system -- it is -- measurement of the focal position in the exposure side of a sensitization substrate -- the measure point of a limited individual -- and it is an error resulting from carrying out at the time of slit scan exposure, and can classify into the following two errors

(1) For example, originate in the operation method for the position of the measure point in the case of measuring a focal position by the multipoint on exposure side 5a of a sensitization substrate, and searching for the fields 36A and 36B for alignment (focal field), as shown in drawing 15 (a) and (b). The error of the gap with the focal side 36A and an ideal focus side, and (2) Error by the difference with the slew rate of a scanning speed, an autofocus mechanism, and an auto leveling mechanism, the speed of response of a focal position detection system, etc.

[0026] In this case, the speed of response in the case of doubling a focal position with the image surface of a projection optical system (focal response) is determined by a time-lag error as shown in drawing 15 (c), and servo gain as shown in drawing 15 (d). That is, in drawing 15 (c), curvilinear 37A shows the driving signal for the directions of a focus for doubling a series of subregions of exposure side 5a of a sensitization substrate with the image surface of a projection

optical system one by one (target focus position signal), and curvilinear 38A shows the signal (flattery focus position signal) which converted the movement magnitude to the direction of a focus of a series of subregions of exposure side 5a into the driving signal, and was acquired. Only fixed time is behind in curvilinear 38A to curvilinear 37A. Similarly, in drawing 15 (d), the target focus position signal of a series of subregions of exposure side 5a of a sensitization substrate and curvilinear 38B of curvilinear 37B are the flattery focus position signals of a series of subregions of exposure side 5a, and, as for the amplitude (servo gain) of curvilinear 38B, only the constant rate is small to curvilinear 37B.

[0027] With the 1st field positioning equipment of this invention, in order to remove these errors, the responsibility of the direction of a scan of a leveling mechanism and the responsibility of the direction of a non-scan are changed. It is premised on the focal position detection system of an oblique incidence type multipoint as a multipoint measurement means for auto leveling mechanisms in this invention. Moreover, it aims at making maximum of the gap with each point of the exposure side in the predetermined field, and the image surface of a projection optical system into the minimum regardless of the average field of the exposure side of the sensitization substrate in the predetermined field in the exposure field of a projection optical system. Thus, in the predetermined field in the exposure field of a projection optical system, the exposure field in case the maximum of the gap with almost all the points of the exposure side of a sensitization substrate and the image surface of a projection optical system is the minimum is called "good field (Good Field)."

[0028] First, as shown in drawing 16 , it is assumed that many measure points (un-illustrating) of a focal position are in the exposure field 24 of the shape of a conjugate slit about slit-like a lighting field and a projection optical system. In drawing 16 , width of face of the direction of a scan of WX and the exposure field 24 is set [the width of face of the direction of a scan of the shot field SAij] to D for the width of face of WY and the direction of a non-scan as what scans one shot field SAij on a sensitization substrate by speed V/beta in the direction of Y to the slit-like exposure field 24. Moreover, by equalizing the focal position in many measure points in central field 24a in the exposure field 24 It asks for the focal position of the average field in the central point of the exposure field 24. It is based on the least squares approximation from the focal position in the measure point in measurement field 24b of the ends of the direction of a scan of the exposure field 24, and 24c, and is tilt-angle thetaY of the direction of a scan of an average field. It asks. It is based on the least squares approximation from the focal position in the measure point in measurement field 24b of the ends of the direction of a non-scan of the exposure field 24, and 24c, and is tilt-angle thetaX of the direction of a non-scan of an average field. It shall ask. Moreover, the value of fm and fn is set up independently, using response frequency of leveling of fm [Hz] and the direction of a non-scan as fn [Hz] for the response frequency of leveling of the direction of a scan.

[0029] And the period of the periodic deflection of the direction of a scan of the shot field SAij on a sensitization substrate Bend as a value of a ratio with the width of face WY (the direction of a non-scan is also set as the same deflection period) of the direction of a scan, and it expresses with Parameter F. The focal error in each measure point in the exposure field 24 in case there is the periodic deflection is expressed with the absolute value of the average of the focal error at the time of carrying out a scan, and one third of the sums of the amplitude of the focal error at the time of carrying out a scan. Moreover, the amplitude of the periodic deflection of the deflection parameter F is standardized to 1, and the error parameter S which shows the maximum of the focal errors in each [these] measure point in case a deflection parameter is F is expressed as a ratio to the deflection parameter F. That is, the following formula is materialized.

The period of F= deflection / WY (1)

The maximum/F of S= focus error (2)

[0030] Drawing 17 (a) expresses the error parameter S to the deflection parameter F when the response frequency fm of leveling of the direction of a scan and the response frequency fn of leveling of the direction of a non-scan are equal and large. A curve A1 The absolute value of the average of a focal error usual [in the error parameter S of the direction of a non-scan] in the error parameter S and curve B1 in the direction of a non-scan, As for a curve A2, the error parameter S and curvilinear B-2 in the direction of a scan show the average of the usual focal error in the error parameter S of the direction of a scan. The curve A1 and the curve A2 express the respectively more realistic focal error. When [when the value of Meter F is small] the period of the irregularity of an exposure side is small, as for the flattery nature of leveling control of the direction of a scan, it turns out that leveling control of the direction of a scan comes to follow deflection bad (curve A2) as a concavo-convex period becomes large. Moreover, since a focal position does not change serially like the direction of a scan to the direction of a non-scan, even if the period of deflection becomes large, it is worse than the flattery nature of the direction of a scan (curve A1). As mentioned above, although the focal error of a bird clapper is desirable so that Parameter S may become 0.5 or less, the direction of a scan and the direction of a non-scan of a focal error are large as a whole.

[0031] On the other hand, the response frequency fm of drawing 17 (b) of leveling of the direction of a scan is larger than the response frequency fn of leveling of the direction of a non-scan. And the error parameter S to the deflection parameter F when both the response frequency fm and fn is small is expressed. In a curve A3, the absolute value of the average of the focal error of the direction of a non-scan usual in the error parameter S and curve B3 in the direction of a non-scan and a curve A4 show the error parameter S in the direction of a scan, and a curve B4 shows the absolute value of the average of the usual focal error in the direction of a scan. Comparison with drawing 17 (a) and drawing 17 (b) shows that the direction when response frequency is almost smaller than the case of a full response (drawing 17 (a)) (drawing 17 (b)) is 0.5 closely, and a focal error has [the error parameter S] it. [small] This is for the fine point on a sensitization substrate that precision will get worse in the slit-like exposure field 24 if an auto leveling mechanism follows unevenly to occur. However, since it becomes impossible to follow to the uneven section of low frequency when response frequency is made small too much, it is necessary to set response frequency as a suitable value.
[0032] Moreover, in the example of drawing 17 (b), the response frequency fm of leveling of the direction of a scan is set up more highly than the response frequency fn of leveling of the direction of a non-scan. Even if this is the irregularity of the same deflection parameter F, since a period becomes short substantially according to slit width, in the direction of a scan, the response frequency for following the irregularity of an exposure side good is because it is necessary to make it higher in the direction of a scan than the direction of a non-scan.
[0033] Moreover, it sets to two or more measure points where the multipoint measurement means for auto leveling mechanisms consists of two or more points in the field of this side at the time of a sensitization substrate (5) being scanned to the inside of two or more points in a conjugate exposure field (24), and the conjugate exposure field of those about the lighting field and projection optical system (8) of the predetermined configuration. When measuring the height of a sensitization substrate (5), respectively, in a front measure point, a read ahead of a focal position is performed partially. This is called "division read ahead." Therefore, compared with the technique (full read ahead) of predicting in all measure points, the length at the time of reading a focal position with a multipoint measurement means by exposure (inlet length) is shortened.
[0034] Moreover, when the multipoint measurement means changes the position of the measure point of these plurality to one shot field of a sensitization substrate (5) one by one in the process which exposes the pattern of a mask (12) one by one, for example at the edge of the shot field, a division read ahead is performed, henceforth [the center section of the shot field], a full read ahead is performed and open control is checked by the exposure position detecting element. Thereby, where leveling precision is maintained with high precision, the inlet length in the edge of a shot field can be shortened, and the throughput of exposure can be raised.
[0035] Next, the autofocus control in the 2nd field positioning equipment of this invention is considered. If the concept of the above-mentioned good field (Good Field) is taken in, as shown in drawing 16 , precision may get worse by performing equalization processing of the focal position of each measure point in center-section 24a of the exposure field 24, and doubling with the image surface of a projection optical system the field shown by the average of the focal position. That is, drawing 18 (a) shows field 34A corresponding to the average of the focal position of each measure point of exposure side 5a with the crevice of depth H of a sensitization substrate, and the difference deltaZ3 of the direction of a focus of the field 34A and crevice is large from H/2.
[0036] On the other hand, in this invention, the maximum and the minimum value of a focal position of each measure point in a measurement field predetermined [on exposure side 5a] are calculated, and the field corresponding to the middle focal position of these maximums and the minimum value is doubled with the image surface of a projection optical system. Drawing 18 (b) is the maximum Zmax of the focal positions of each measure point in exposure side 5a with the crevice of depth H of a sensitization substrate. Minimum value Zmin Field 34B corresponding to a middle focal position is shown, and it is focal position Z34of field 34B B. It can express as follows.
Z34B =(Zmax +Zmin)/2 (3)
[0037] Then, the field 34B doubles with the image surface of a projection optical system. Moreover, the difference deltaZ4 of the direction of a focus of field 34B and the front face of exposure side 5a and the difference deltaZ5 of the direction of a focus of field 34B and its crevice are H/2 mostly, respectively. That is, since the direction of field 34B of drawing 18 (b) becomes [the maximum of the error of the focal position in each point on exposure side 5a] small compared with field 34A of drawing 18 (a), on the concept of the good field (Good Field), the exposure side of a sensitization substrate can be doubled more with high degree of accuracy by this invention at the image surface of a projection optical system.
[0038] Furthermore, the property of the error parameter S over the deflection parameter F at the time of performing autofocus control based on equalization processing of drawing 18 (a) or autofocus control based on the average of the maximum of drawing 18 (b) and the minimum value is shown in drawing 19 (a) and (b), respectively at the same time it makes the response frequency fm of leveling of the direction of a scan, and response frequency fn of leveling of the

direction of a non-scan equally and large and performs auto leveling control like drawing 17 (a). That is, in curvilinear A5 and B5, in drawing 19 (a) based on equalization processing, the error parameter S, the curve A6, and B6 of the direction of a non-scan express the error parameter S of the direction of a scan, respectively. Moreover, in drawing 19 (b) based on the average of maximum and the minimum value, curves A7 and B7 express the error parameter S of the direction of a non-scan, and curves A8 and B8 express the error parameter S of the direction of a scan, respectively.

[0039] drawing 19 (b) -- the Ming kana -- like, when autofocus control is performed based on the average of maximum and the minimum value, while the value of the error parameter S is 0.5 in all the deflection parameters F, i.e., all frequency bands, closely, compared with the case where autofocus control is performed based on equalization processing, the maximum of a focal error is small

[0040] Moreover, it returns to drawing 15 (a) and (b), and when only autofocus control is performed based on the average of the maximum of a focal position and the minimum value which were obtained in the measure point in a predetermined measurement field, as shown in drawing 15 (a), field 36A of deltaZa doubles with the image surface of a projection optical system in the difference of a focal position with maximum to exposure side 5a which has the deflection of amplitude 2 and deltaZa. On the other hand, while performing autofocus control based on the average of the focal position only obtained in these measure points to exposure side 5a which has the deflection of amplitude 2 and deltaZa If auto leveling control is performed based on the least squares approximation of the obtained focal position, as shown in drawing 15 (b) Field 36B of deltaZb (>deltaZa) may double with the image surface of a projection optical system in the difference of the focal position from maximum within the limits of amplitude deltaZc (>2 and deltaZa). Therefore, a focal error becomes [the direction which performs autofocus control based on the average of the maximum of a focal position and the minimum value which were obtained] small, when using an auto leveling mechanism, or even when not using it.

[0041] In addition, although it is controlling by this invention to double with the image surface the field which becomes settled in the (minimum value Zmin of the maximum Zmax+ focus position of a focal position) / 2, depending on a device process, which the depth of focus of the heights of exposure side 5a of a sensitization substrate or a crevice may be required. Therefore, it is desirable to perform control which doubles with the image surface the field of the focal position ZMN which becomes settled in proportional distribution like the following formula using the predetermined coefficients M and N.

ZMN=(M-Zmax+N-Zmin)/(M+N) (4)

[0042]

[Example] Hereafter, with reference to a drawing, it explains per example of this invention. this example applies this invention to the autofocus mechanism and auto leveling mechanism of a projection aligner of a slit scan exposure method. Drawing 1 shows the projection aligner of this example, the pattern on a reticle 12 is illuminated by the lighting field (henceforth a "slit-like lighting field") of the rectangle by the exposure light EL from the lighting optical system by which the illustration ellipsis was carried out in this drawing 1 , and projection exposure of the image of the pattern is carried out on a wafer 5 through a projection optical system 8. Under the present circumstances, synchronizing with a reticle 12 being scanned by constant speed V in the direction of this side (or other side) to the space of drawing 1 , a wafer 5 is scanned by the other side (or the direction of this side) to the space of drawing 1 to the lighting field of the shape of a slit of the exposure light EL by constant-speed V/beta (1/beta is the reduction scale factor of a projection optical system 8).

[0043] The reticle Y drive stage 10 which can be freely driven to Y shaft orientations (direction perpendicular to the space of drawing 1) on the reticle susceptor 9 is laid for explaining the drive system of a reticle 12 and a wafer 5, the reticle minute drive stage 11 is laid on this reticle Y drive stage 10, and the reticle 12 is held by the vacuum chuck etc. on the reticle minute drive stage 11. As for the reticle minute drive stage 11, only a minute amount performs position control of a reticle 12 to the direction of X parallel to space, the direction of Y, and hand of cut (the direction of theta) of drawing 1 with high precision in a field perpendicular to the optical axis of a projection optical system 8, respectively. It always acts as the monitor of the position of the direction of X of the reticle minute drive stage 11, the direction of Y, and the direction of theta with the interferometer 14 which the move mirror 21 has been arranged on the reticle minute drive stage 11, and has been arranged on the reticle susceptor 9. The positional information S1 obtained by the interferometer 14 is supplied to main-control system 22A.

[0044] The wafer Y-axis drive stage 2 which can be freely driven to Y shaft orientations on the wafer susceptor 1 on the other hand is laid, the wafer X-axis drive stage 3 which can be freely driven to X shaft orientations on it is laid, Z leveling stage 4 is formed on it, and the wafer 5 is held by vacuum adsorption on this Z leveling stage 4. The move mirror 7 is fixed also on Z leveling stage 4, it acts as the monitor of the position of the direction of X of Z leveling stage 4, the direction of Y, and the direction of theta with the interferometer 13 arranged outside, and the positional information obtained by the interferometer 13 is also supplied to main-control system 22A. Main-control system 22A

controls operation of the whole equipment while controlling positioning operation of the wafer Y-axis drive stage 2, the wafer X-axis drive stage 3, and Z leveling stage 4 through wafer driving gear 22B etc.

[0045] Moreover, in order to take correspondence of the wafer system of coordinates specified by the coordinate measured by the interferometer 13 by the side of a wafer, and the Reticulum label system specified by the coordinate measured by the interferometer 14 by the side of a reticle, the reference-mark board 6 is being fixed near the wafer 5 on Z leveling stage 4. Various reference marks are formed on this reference-mark board 6. In these reference marks, the reference mark currently illuminated from the background by the lighting light led to Z leveling stage 4 side, i.e., a luminescent reference mark, is prepared.

[0046] The reticle alignment microscopes 19 and 20 for observing simultaneously the reference mark on the reference-mark board 6 and the mark on a reticle 12 are equipped above the reticle 12 of this example. In this case, if the deviation mirrors 15 and 16 for leading the detection light from a reticle 12 to the reticle alignment microscopes 19 and 20, respectively are arranged free [movement] and an exposure sequence is started, the deviation mirrors 15 and 16 will shunt with the mirror driving gears 17 and 18 under the instructions from main-control system 22A, respectively.

[0047] It equips with the oblique-incidence type multipoint focus position detection system of the conventional method explained to the projection aligner of the slit scan method of drawing 1 with reference to drawing 20 and drawing 21 . However, while the multipoint focus position detection system of this example has more number of a measure point than the conventional example, arrangement of a measure point is devised. As drawing 2 (b) shows pattern formation board 62A of this example corresponding to the conventional pattern formation board 62 of drawing 21 (b) and shows it to drawing 2 (b), the opening pattern 72-11 to 72-19 of the shape of nine slit is formed in eye the 1st train of pattern formation board 62A, and nine opening patterns 72-12 to 72-59 are formed also in eye the 5th train [eye the 2nd train -], respectively. That is, the opening pattern of the shape of 45 slit is formed in pattern formation board 62A in total, and the image of the opening pattern of the shape of these slit is aslant projected to the X-axis and a Y-axis on the exposure side of the wafer 5 of drawing 1 .

[0048] Drawing 2 (a) shows the exposure side of the wafer 5 of the lower part of the projection optical system 8 of this example, the pattern of the reticle 12 of drawing 1 is exposed in this drawing 2 (a) in the exposure field 24 of a rectangle long in the direction of X inscribed in the circular lighting visual field 23 of a projection optical system 8, and a wafer 5 is scanned in the direction of Y to this exposure field 24 (scan). By the multipoint focus position detection system of this example Nine measure points AF11-AF19 of the 1st train extended in the direction of X of the direction top of Y of the exposure field 24, The measure points AF21-AF29 of the 2nd train, The image of a slit-like opening pattern is projected on the measure points AF31-AF39 of the 3rd train in the exposure field 24, the measure points AF41-AF49 of the 4th train of the direction bottom of Y of the exposure field 24, and the measure points AF51-AF59 of the 5th train, respectively.

[0049] Drawing 2 (c) shows electric-eye 69A of the multipoint focus position detection system of this example, nine photo detectors 75-11 to 75-19 are arranged on this electric-eye 69A at eye the 1st train, and nine photo detectors 75-12 to 75-59 are arranged also at eye the 5th train [eye the 2nd train -], respectively. That is, 45 photo detectors are arranged in total by electric-eye 69A, and slit-like drawing (illustration ellipsis) is arranged on each photo detector. Moreover, re-image formation of the image of the opening pattern of the shape of a slit projected in the measure points AF11-AF59 of drawing 2 (a), respectively on these photo-detectors 75-11 - 75 -59 is carried out. And on electric-eye 69A, it vibrates in the direction of RD whose position of each image by which re-image formation was carried out is the cross direction of drawing by carrying out rotational vibration of the light reflected in respect of exposure of a wafer 5 by the diaphragm corresponding to the hand-of-cut diaphragm 67 of drawing 20 .

[0050] When the detecting signal of each photo detector 75-11 to 75-59 is supplied to signal processor 71A and carries out the synchronous detection of each detecting signal by the signal of rotational-vibration frequency in signal disposal equipment 71A Like [45 focal signals corresponding to the focal position of each measure points AF11-AF59 on a wafer are generated, and / signal / focal / of these 45 focal signals / predetermined] the after-mentioned The tilt angle (leveling angle) and the average focal position of an exposure side of a wafer are computed. The leveling angle and the focal position which were these-measured are supplied to main-control system 22A of drawing 1 , and main-control system 22A performs the leveling angle of a wafer 5, and a setup of a focal position through driving gear 22B and Z leveling stage 4 based on the leveling angle and focal position which were supplied.

[0051] Therefore, in this example, the focal position of all 45 measure points AF11-AF59 shown in drawing 2 (a) is measurable. However, in this example, as shown in drawing 3 , the position of the point (henceforth a "sample point") which actually measures a focal position all over these 45 measure points according to the direction of a scan of a wafer is changed. When carrying out the scan of the wafer in the direction of Y to the exposure field 24, and in performing a division read ahead like the after-mentioned as an example as shown in drawing 3 (a), the odd-numbered measure points AF21, AF23, ..., AF29 in the measure point of 2nd train 25B and the even-numbered measure points

AF32, AF34, .., AF38 in the exposure field 24 turn into a sample point. Moreover, when carrying out the scan of the wafer in the direction of -Y to the exposure field 24, and in performing a division read ahead like the after-mentioned as shown in drawing 3 (b), the odd-numbered measure points AF41, AF43, ..., AF49 in the measure point of 4th train 25D and the even-numbered measure points AF32, AF34, .., AF38 in the exposure field 24 turn into a sample point.
[0052] Furthermore, since the measurement result of the focal position at the time of slit scan exposure changes serially according to the move coordinate of the stage by the side of a wafer, the measurement result of these focus position is memorized by the storage in main-control system 22A of drawing 1 as a two-dimensional map which consists of a coordinate of the direction of a scan of a stage, and a coordinate of the measure point of the direction of a non-scan. Thus, the focal position and leveling angle of a wafer at the time of exposure are computed using the memorized measurement result. And when actually driving Z leveling stage 4 of drawing 1 and setting up the focal position and leveling angle of an exposure side of a wafer, operation of Z leveling stage 4 is controlled by open loop control according to a measurement result. In this case, exposure in the exposure field 24 is performed based on the result measured beforehand. That is, as shown in drawing 4 (a), measurement of the focal position of the field 26 on a wafer is performed, for example by the predetermined sampling point of the measure point of 2nd train 25B, and as shown in drawing 4 (b) after that, when the field 26 on a wafer reaches in the exposure field 24, based on the measurement result in drawing 4 (a), focusing of the field 26 on a wafer and leveling control are performed.
[0053] Z leveling stage 4 and this control system of this example [drawing 5] -- being shown -- this drawing 5 -- setting -- the upper surface member of Z leveling stage 4 -- an inferior surface of tongue -- a member -- it is supported through the three supporting points 28A-28C upwards, and each supporting points 28A-28C can be expanded now and contracted in the direction of a focus, respectively adjusting the amount of expansion and contraction of each supporting points 28A-28C -- tilt-angle thetaY of the focal position of the exposure side of the wafer 5 on Z leveling stage 4, and the direction of a scan And tilt-angle thetaX of the direction of a non-scan It can be set as a desired value. Near each supporting points 28A-28C, the amount of displacement of the direction of a focus of each supporting point is attached in the height sensors 29A-29C measurable with the resolution of about 0.01 micrometers, respectively. In addition, you may establish independently the highly precise mechanism in which a stroke is more long as a positioning mechanism to the direction of a focus (Z direction).
[0054] tilt-angle thetaX which looks like [the filter sections 30A and 30B] main-control system 22A every moment, respectively, and changes in order to control leveling operation of Z leveling stage 4 and which should set up the direction of a non-scan And tilt-angle thetaY which should set up the direction of a scan It supplies. The filter sections 30A and 30B supply the tilt angle filtered and obtained by filter shape different, respectively to operation part 31, and main-control system 22A supplies the coordinate W of the field made applicable [on a wafer 5] to exposure (X, Y) to operation part 31. Operation part 31 supplies the information on the amount of displacement which should be set as mechanical components 32A-32C based on Coordinate W (X, Y) and two tilt angles. The information on the present height of the supporting points 29A-29C is also supplied to each mechanical components 32A-32C from the height sensors 29A-29C, respectively, and each mechanical components 32A-32C set the height of the supporting points 29A-29C as the height set as operation part 31, respectively.
[0055] Thereby, although the tilt angle of the direction of a scan of the exposure side of a wafer 5 and the tilt angle of the direction of a non-scan are set as a desired value, respectively, the response frequency fm of leveling of the direction of a scan [Hz] is more highly set up by the difference of the property of the filter sections 30A and 30B from the speed of response fn of leveling of the direction of a non-scan [Hz] in this case. The speed of response fn of leveling of 10Hz and the direction of a non-scan of the response frequency fm of leveling of the direction of a scan is 2Hz as an example.
[0056] Moreover, if the position where the supporting points 28A, 28B, and 28C are arranged is called driving points tangent line1, tangent line2, and tangent line3, respectively, the driving points tangent line1 and tangent line2 are arranged on 1 straight line parallel to a Y-axis, and the driving point tangent line 3 is located on perpendicular 2 bisectrix with the driving points tangent line1 and tangent line2. And if the exposure field 24 of the shape of a slit by the projection optical system shall be located on the shot field SAij on a wafer 5, in case it will perform leveling control of a wafer 5 through the supporting points 28A-28C in this example, the focal position of the shot field SAij does not change. Therefore, it is carried out in the form which leveling control and focal control separated. Moreover, a setup of the focal position of the exposure side of a wafer 5 is performed when only the same amount carries out the variation rate of the three supporting points 28A-28C.
[0057] Next, it explains to a detail per leveling operation of this example, and focusing operation. First, the method of computing the tilt angle for leveling and the focal position for focusing is shown.
(A) it is shown in computing method drawing 4 of a tilt angle -- as -- the measure point of each train -- setting -- the X coordinate of the m-th sample point of the direction of a non-scan -- the Y coordinate of the n-th sample point of Xm

and the direction of a scan -- Yn ** -- carrying out -- X coordinate Xm And Y coordinate Yn The value of the focal position measured at the sample point is expressed with AF (Xm and Yn). Moreover, the following operation is performed, using the number of samplings of M and the direction of a scan as N for the measurement size of the direction of a non-scan. However, sum operation sigmam The sum to 1-M about Subscript m is expressed.
[0058]
SX=sigma m Xm, SX2=sigmam Xm2, SMZ=sigma m AF (Xm and Yn) SXZ=sigmam (AF (Xm and Yn) and Xm) (5)
Similarly, it is sum operation sigman. The following operation is performed as a thing showing the sum to 1-N about Subscript n.
SY=sigma n Yn, SY2=sigman Yn2, SNZ=sigma n AF (Xm and Yn) SYZ=sigman (AF (Xm and Yn) and Yn) (6)
[0059] And the following operation is performed using (5) formulas and (6) formulas.
An=(SX-SMZ-M-SXZ)/(SX2-M-SX2) (7)
Am=(SY-SNZ-N-SYZ)/(SY2-N-SY2) (8)
next, every -- the tilt angle AL (Yn) of the direction [in / the n-th sample point of the direction of a scan / by the least squares approximation / from An] of a non-scan (the direction of X) -- asking -- every -- it asks for the tilt angle AL (Xm) of the direction of a scan in the m-th sample point of the direction of a non-scan (the direction of Y) by the least squares approximation from Am Then, it is tilt-angle thetaX of the direction of a non-scan by the following equalization processings. And tilt-angle thetaY of the direction of a scan It asks.
thetaX =(sigman AL (Yn))/N (9)
thetaY = (sigmam AL (Xm)) (10)
[0060] (B) There are an equalization approach and the maximum minimum detecting method as method of computing the focal position computing method focus position, and compute a focal position by the maximum minimum detecting method in this example. By the equalization approach, the focal position <AF> as the whole exposure side of a wafer 5 is calculated from the following formula using the value AF of an above-mentioned focal position (Xm and Yn) for reference.
<AF> =(sigman sigmam AF (Xm and Yn))/(M-N) (11)
[0061] Next, focal position AF' as the whole exposure side of a wafer 5 is calculated from the following formula by setting to Max ( ) and Min ( ) the function which expresses maximum and the minimum value with the maximum minimum detecting method, respectively.
AF'= (Max(AF (Xm and Yn)) +Min(AF (Xm and Yn)) /2 (12))
and -- the time of the measured field 26 arriving at the exposure field 24, as shown in drawing 4 (b) -- detection result thetaX of (9) formulas, (10) formulas, and (12) formulas, and thetaY And based on AF', the three supporting points 28A-28C of drawing 5 drive with an open loop on the basis of the measurement result of the height sensors 29A-29C, respectively. Autofocus control is concretely performed by driving simultaneously the three supporting points 28A-28C, and auto leveling control is performed so that the focal position in the exposure field 24 shown in drawing 5 may not change.
[0062] In drawing 5 the interval of the direction of X of the central point of the exposure field 24, and the supporting points 28A and 28B Namely, X1, They are the central point of Y1 and the exposure field 24, and the interval of the direction of Y of supporting-point 28B about the central point of X2 and the exposure field 24, and the interval of the direction of Y of supporting-point 28A in the central point of the exposure field 24, and the interval of the direction of X of supporting-point 28C Y2 It carries out. Tilt-angle thetaX of the direction of a non-scan It is based on a result and is X1, respectively to the supporting points 28A and 28B and supporting-point 28C. : X2 The variation rate of an opposite direction is given by the ratio. Tilt-angle thetaY of the direction of a scan It is based on a result and is Y1 to supporting-point 28A and supporting-point 28B, respectively. : Y2 The variation rate of an opposite direction is given by the ratio.
[0063] Moreover, in the above-mentioned approach, since a focal position and a tilt angle change every moment according to an aligner, there is amendment need about the measurement value of an actual focal position. Drawing 6 (a) shows the state where of the focal position and tilt angle of ****** are measured in the measure point (AF point) of a certain focal position, and the amount of drives <tangent line1>, <tangent line2>, and <tangent line3> of the direction of a focus of the supporting point at each driving points tangent line1-tangent line3 of drawing 5 presuppose that it is it 0 (criteria position) in the state of drawing 6 (a), respectively. [the whole field 26 on exposure side 5a of a wafer And as the field 26 shows drawing 6 (b), when the exposing point in the exposure field is reached, the amount of these drives is set as <tangent line1>=a, <tangent line2>=b, and <tangent line3> =c, respectively for exposure. In this case, although only deltaF is changing compared with the case of drawing 6 (a), the focal position of field 26A currently measured in the measure point (AF point) of a focal position Since the influence of the amount of drives in each driving points tangent line1-tangent line3 is included in the variation of this deltaF, when exposing field 26A next, it is

necessary to perform leveling and focusing for the amount of drives of each driving points tangent line1-tangent line3 in the state of drawing 6 (b) with an amended type.

[0064] That is, the tilt angle of the focal position measured about field 26A as F1, theta1X, and theta1Y, respectively in the tilt angle of the focal position measured about the field 26 and the direction of X and the tilt angle of the direction of Y and the direction of X and the tilt angle of the direction of Y are made into Fn ', thetanX', and thetanY', respectively. Moreover, when the interval of the direction of X of the measure point (AF point) of a focal position and an exposing point and the direction of Y is set to delta X and delta Y, respectively, the amount deltaF1 of amendments of a focal position is as follows.

deltaF1=-F1-theta1 X-delta X-theta 1 Y-delta Y (13)

[0065] When the amount deltaF1 of amendments is used, the value Fn, thetanX, and thetanY after each amendment of the tilt angle of the focal position measured about field 26A and the direction of X and the tilt angle of the direction of Y are as follows.

Fn =Fn '+deltaF1 (14)

theta nX=theta nX'-theta1X (15)

theta nY=theta nY'-theta1Y (16)

Moreover, it is necessary to manage responsibility so that it may not follow to the uneven side of the RF of the exposure side of a wafer 5. That is, since the response corresponding to the stage position is required when the scan speed of a wafer 5 changes, it is made the mechanism which manages the focal position and tilt angle which were measured with the numerical filter for fast Fourier transforms (FFT), or can carry out adjustable [of the servo gain of the mechanical component of the three supporting points 28A-28C of drawing 5] according to speed. However, a reserve scan is required for the numerical filter for FFT, and since servo gain has phase lag, the mechanism in consideration of these is required.

[0066] (C) a servo gain adjustable method -- here explains per example of the method of carrying out adjustable [of the servo gain of the mechanical component of the three supporting points 28A-28C of drawing 5] according to speed When response frequency in case the scan speed of a wafer is V/beta is set to nu, transfer function G (s) is expressed as follows.

G(s)=1/(1+Ts) (17)

however, T= 1/(2pinu) and s=2pifi -- it comes out

[0067] From the analysis result, when scan speed V/beta was 80 mm/s, the response frequency nu of the direction of a non-scan had optimal 2Hz, and found that 10Hz was the optimal for the response frequency nu of the direction of a scan. However, unevenness of the exposure side of a wafer is expressed with the sine wave of Pitch p, and it is the length of the scanning direction of each shot field on a wafer L0 When it carries out, the frequency f in (17) formulas is as follows.

f=(V/beta)/L0 and (L0 / p) =(V/beta)/p (18)

Therefore, since frequency f will change if scan speed V/beta changes, it is necessary to newly ask for the optimal response frequency nu. Thus, servo gain is determined from the response frequency nu for which it asked.

[0068] (D) the numerical filtering method -- since the pitch p of the irregularity on the exposure side of a wafer is a function depending on the stage position here, if the sampling of a focal position is performed by datum reference synchronizing with a stage position, control independent of scan speed V/beta will be attained that is, the inverse Fourier transform of the transfer function G (s) is carried out to the well which gives the filtering effect equivalent to transfer function G (s) with a position function, it is asked for position function F (x), and numerical filtering is performed to it using this position function F (x) An example of transfer function [of the response frequency nu] G (s) is concretely shown in drawing 7 (a), and position function F (x) corresponding to it is shown in drawing 7 (b). However, it is necessary to take run-up scan distance, and at the time of numerical filtering, when not performing this, phase lag arises.

[0069] In addition, also in which method of an above-mentioned servo gain adjustable method and the numerical filtering methods, responsibility is managed by phase lag and the filtering effect. Phase lag (time lag) is a time lag which exists between the signal corresponding to the focal position made into the target shown by curvilinear 37A of drawing 15 (c), and the signal corresponding to the focal position which is shown by curvilinear 38A, and which was measured in fact. The filtering effect is that only the specified quantity makes the amplitude of an actual focal position small to a focal target position, as the curves 37B and 38B of drawing 15 (d) show.

[0070] As mentioned above, in this example, in case exposure to each shot field of a wafer is performed, the run-up scan which is a preliminary scan may be performed. Then, the setting method of the run-up scan distance is explained. Drawing 8 (a) shows the scanning method in the case of exposing the pattern of a reticle to the next shot fields SA12 and SA13 one by one, after finishing exposure of the shot field SA 11 on a wafer. In this drawing 8 (a), after it scans a

wafer in the direction of -Y and the exposure to the shot field SA 11 on a wafer finishes, a wafer is aslant moved to the X-axis and a Y-axis between the acceleration-and-deceleration periods TW1, and it arranges near the soffit of the next shot field SA 12 in the exposure field of a projection optical system. After the exposure to the first shot field SA 11 finishes, while moving near the soffit of the next shot field SA 12, movement of interval deltaL is performed in the direction of Y. Moreover, in the telophase of the acceleration-and-deceleration period TW1, movement in the direction of Y of a wafer is started.

[0071] Between the subsequent establishment (setting) periods TW2, the scan speed of a wafer reaches about V/beta, and exposure of the pattern of the reticle to the shot field SA 12 is performed between the exposure periods TW3 following it. The acceleration-and-deceleration period TW1, the establishment period TW2, and the exposure period TW3 by the side of a wafer in this case are shown in drawing 8 (c), and the acceleration-and-deceleration period TR1, the establishment period TR2, and the exposure period TR3 by the side of a reticle are shown in drawing 8 (b). In addition, in a reticle side, since it is not necessary to move to the next shot field like drawing 8 (a), movement of the stage by the side of a reticle is reciprocating movement in alignment with a Y-axis. Moreover, it is ts at the time of the grade which shifts to the establishment period TW2 from the acceleration-and-deceleration period TW1 in a wafer side as shown in drawing 8 (c). The sampling of the focal position by the shell and the multipoint focus position detection system is started.

[0072] in this example, by phase lag and the filtering effect, since the responsibility at the time of leveling and focusing is managed, the start point when starting the sampling of a focal position by the wafer up changes with situations For example, as what synchronizes a sampling with a stage position, supposing it performs numerical filtering, a sampling starting position will be determined by the following procedure.

[0073] First, transfer function G (s) is given like drawing 7 (a), and from this transfer function G (s), it asks for position function [of drawing 7 (b)] F (x) by the inverse Fourier transform, and asks for length deltaL from the zero of this position function F (x) to a zero crossing point. This length deltaL is equal to movement magnitude deltaL to the direction of Y at the time of moving aslant because of exposure of the next shot field SA 12, as shown in drawing 8 (a).

[0074] Moreover, to the acceleration-and-deceleration period TR1 of a reticle, since the acceleration-and-deceleration period TW1 of a wafer is small, time (TR1-TW1) turns into the latency time by the side of a wafer. In this case, although it does not become the fall of a throughput at the time of deltaL< (V/beta) (TR1-TW1) and **, it becomes the fall of a throughput at the time of deltaL> (V/beta) (TR1-TW1) and **. in addition, delta Y=delta L- (V/beta) (TR1-TW1) and length [which is come out of and expressed] deltaY is good as a fixed function, if the same filtering effect as transfer function G (s) is acquired even if it processes as phase lag By performing these filtering, the effect of reducing the influence of the air fluctuation to a multipoint focus position detection system and the control error of a multipoint focus position detection system is also expectable.

[0075] Next, arrangement of the sample point in the measure point of the multipoint focus position detection system in the projection aligner of the slit scan exposure method of this example is considered. First, in drawing 2 (a), among the measure points AF11-AF59 by the multipoint focus position detection system, when using the measurement result of the focal position of the measure points AF31-AF39 in the slit-like exposure field 24 (i.e., when making measure points AF31-AF39 into a sample point), control by same "the exposure position control method" as the conventional stepper's case is performed. Furthermore, since the scan of the wafer of this example is performed in the direction of Y, or the direction of -Y, it is arranging the sample in a measure point before a scanning direction to the exposure field 24, and read-ahead control, time-sharing leveling measurement, measurement value equalization, etc. are attained.

[0076] Read-ahead control means choosing a sample point out of the measure point AF 41 before a scan - AF49, AF51-AF59, when carrying out the scan of the wafer [like] to drawing 2 (a) in the direction of -Y to the exposure field 24. By performing read-ahead control, the following error to actual response frequency becomes |1-G(s) | to transfer function [of an autofocus mechanism and an auto leveling mechanism] G (s). However, since phase lag and the filtering error factor are contained in this following error, phase lag can be removed if read-ahead control is performed. Since this error is 1-G[|] (s) |, the transfer capacity to be about 4 times many as this can be given.

[0077] Drawing 9 (a) showed the curvilinear 39A corresponding to the focal position made into the target at the time of performing the same exposure position control as usual, and the curvilinear 38 B corresponding to the actually set-up focal position, drawing 9 (b) showed the curvilinear 40A corresponding to the focal position made into the target at the time of performing read-ahead control, and the curvilinear 40 B corresponding to the actually set-up focal position, and a phase has shifted in exposure position control. Therefore, the difference Fa of the target position in the case of exposure position control and a flattery position will be about 4 times the difference Fb of the target position in read-ahead control, and a flattery position. Therefore, in read-ahead control, the transfer capacity to be about 4 times many as this can be given.

[0078] However, as already stated, since about 10Hz is suitable (position control method), when the response frequency of auto leveling performs read-ahead control in the direction of a scan, it will be good at the filtering response of about 2.5Hz in the direction of a scan. When a numerical filter or control gain performs this filtering, the run-up scan length about 5(**80/(2pi*2.5)) mm is needed before exposure, using the scan speed of a wafer as 80mm. The focal error by both the controlling method is shown below.

[0079] Therefore, like the case of drawing 17 , it turns at the period of the periodic deflection of the direction of a scan of the shot field SAij on a wafer as a value of a ratio with the width of face of the direction of a scan, and expresses with Parameter F, and the focal error in each measure point in case there is the periodic deflection is expressed with the absolute value of the average of the error of the focal position in each measure point, and one third of the sums of the amplitude of the error of a focal Moreover, the amplitude of the periodic deflection of the deflection parameter F is standardized to 1, and the error parameter S which shows the maximum of the focal errors in each [these] measure point in case a deflection parameter is F is expressed as a ratio to the deflection parameter F.

[0080] The response frequency fn of leveling of 10Hz and the direction of a non-scan expresses the error parameter S to the deflection parameter F when drawing 10 (a) performs exposure position control, and in case the response frequency fm of leveling of the direction of a scan is 2Hz, curvilinear A9 and B9 show the error parameter S in the direction of a non-scan, and both the curves A10 and B10 of both show the error parameter S in the direction of a scan. The response frequency fn of leveling of 2.5Hz and the direction of a non-scan expresses the error parameter S to the deflection parameter F when drawing 17 (b) performs read-ahead control on the other hand, and in case the response frequency fm of leveling of the direction of a scan is 0.5Hz, curves A11 and B11 show the error parameter S in the direction of a non-scan, and both the curves A12 and B12 of both show the error parameter S in the direction of a scan.

[0081] Although it is good in order to improve a response, it is not suitable to remove phase lag by read-ahead control as mentioned above when reducing a response. However, read-ahead control has much flexibility in software, and can also perform time equalization as shown by drawing 11 , and a prediction setup of the measure point of the focal position in the time of an exposure start. That is, in drawing 11 (a), a focal position is detected only for the length of width-of-face deltaL in a front sample point (AF point) to the scanning direction of a multipoint focus position detection system to certain field 26B on exposure side 5a of a wafer. And as shown in drawing 11 (b), when field 26B reaches an exposing point, the information on the focal position detected in the range of width-of-face deltaL is equalized, and leveling and focusing are performed with high precision.

[0082] Moreover, as shown in drawing 11 (c), even if level difference section 26C is in exposure side 5a of a wafer by the case where a measure point and an exposing point are equal, by the exposure position control method, as shown in drawing 11 (d), the field (focal field) AFP made into a focal object only goes up gradually, and exposure is performed in the state where it was defocused in the level difference section 26C. On the other hand, when level difference section 26D is in exposure side 5a of a wafer, as are shown in drawing 11 (e), and it is beforehand shown in drawing 11 (f) according to the level difference by the case where the measure point and the exposing point are separated by the read-ahead controlling method, exposure is performed in the state where it focused, by going up the focal side AFP gradually at the level difference section 26D.

[0083] In addition, it has not only the read-ahead controlling method but the usual exposure position control method, and it is desirable to use the two controlling methods as a selectable system. In the auto-focusing and the auto leveling mechanism of this example, since there are the above functions, in order to actually control the exposure side of a wafer, the method of controlling three kinds which consists of ** exposure position control, ** full read-ahead control, and ** division read-ahead control can be considered. Below, it explains to these three kinds of controlling method per details.

(F) Perform the focal position of the exposure side of a wafer, and control of a leveling angle using the value of the focal position measured and obtained regardless of the responsibility ability of auto-focusing and an auto leveling mechanism at all at the time of exposure by the exposure position control method this gentleman formula. Namely, as shown in drawing 12 (a), the odd-numbered measure point of 3rd train 25C in the exposure field 24 is also made into a sample point to the exposure field 24 at a scanning direction (the direction of Y) by making the even-numbered measure point of 2nd train 25B of a near side into the sample point 41. And leveling control of the direction of a scan of the exposure side of a wafer is performed from the measurement value of the focal position in the sample point of 2nd train 25B, and the measurement value of the focal position in the sample point of 3rd train 25C.

[0084] Moreover, it train [2nd] 25B Reaches, the inclination of the direction of a non-scan is calculated by the least-squares-approximation method from the measurement value of the focal position in the sample point of 3rd train 25C, and leveling control of the direction of a non-scan is performed. Moreover, focal control also uses the measurement value of the focal position in the measure point of the 3rd train in the exposure field 24, and performs focal control. In

addition, as shown in drawing 12 (b), when the direction of a scan of a wafer is the direction of -Y, a sample point train [3rd] 25C Reaches, and is chosen from the measure point of 4th train 25D. By this method, although control is the easiest, there is un-arranging [that flattery precision will change with a scanning speed of a wafer etc.]. Moreover, it train [2nd] 25B Reaches and the calibration of the focal position in each measure point of 3rd train 25C is required.
[0085] (G) As shown in drawing 12 (c), measure all the values of the focal position in the sample point of 1st train 25A before exposure beforehand to the exposure field 24 by the full read-ahead controlling method this gentleman formula at the scanning direction by making all the measure points of 1st train 25A of a near side into a sample point. And equalization processing and filtering processing are performed, phase lag is expected, it is open at the time of exposure, and auto-focusing and an auto leveling mechanism are controlled at it. Namely, the measurement value of the focal position in each sample point of 1st train 25A is memorized, the inclination of the direction of a scan is computed from the value of the focal position measured on the time-axis, and leveling control of the direction of a scan is performed by open control at the time of exposure.
[0086] In parallel to it, the inclination of the direction of a non-scan is calculated by the least-squares-approximation method from the measurement value of the focal position in each sample point of 1st train 25A, and leveling control of the direction of a non-scan is performed by open control. Since it is a read ahead, equalization on a time-axis is also possible. Moreover, the measurement value of the focal position in each sample point of 1st train 25A is memorized, and focal doubling is performed by open control at the time of exposure. In addition, as shown in drawing 12 (d), when the scanning direction of a wafer is the direction of -Y, all the measure points of 5th train 25E are chosen as a sample point.
[0087] By this method, since a sample point can secure nine points in 1st train 25A, there is much amount of information and the improvement in precision is expectable. Moreover, since a sample point is one line, it both has the advantage with an unnecessary calibration that management of responsibility can be performed. On the other hand, when it measures directly about the sample point of 1st train 25A, in order to expose the edge of each shot field, the distance (run-up scan length) which should be scanned becomes long, and there is un-arranging [to which a throughput falls]. Moreover, since it is open control, there is also un-arranging [that the check by the multipoint focus position detection system cannot be performed].
[0088] (H) By the division read-ahead controlling method this gentleman formula, as shown in drawing 12 (e), also make the even-numbered measure point of 3rd train 25C in the exposure field 24 into a sample point to the exposure field 24 at a scanning direction (the direction of Y) by making the odd-numbered measure point of 2nd train 25B of a near side into a sample point. And it train [2nd] 25B Reaches and all the values of a focal position are beforehand measured before exposure in the sample point of 3rd train 25C. Then, equalization processing and filtering processing are performed, phase lag is expected, and it controls by open control at the time of exposure. Namely, it train [2nd] 25B Reaches, the measurement value of the focal position in the sample point of 3rd train 25C is memorized, the inclination of the direction of a scan is computed from the value of the focal position measured on the time-axis, and leveling of the direction of a scan is performed by open control at the time of exposure.
[0089] Moreover, it train [2nd] 25B Reaches, the inclination of the direction of a non-scan is calculated by the least-squares-approximation method from the measurement value of the focal position in the sample point of 3rd train 25C, and leveling of the direction of a non-scan is performed by open control. Since it is a read ahead, equalization on a time-axis is also possible. Moreover, it train [2nd] 25B Reaches, the measurement value of the focal position in the sample point of 3rd train 25C is memorized, and focal doubling is performed by open control at the time of exposure. In addition, as shown in drawing 12 (f), when the direction of a scan of a wafer is the direction of -Y, a sample point train [3rd] 25C Reaches, and is chosen from the measure point of 4th train 25D.
[0090] By this method, since 2nd train 25B (or 4th train 25D) is close to the exposure field 24, while being able to lessen run-up scan distance for exposing the edge of each shot field of a wafer, there is an advantage that management of responsibility can be performed. Moreover, the check of the result which controlled the exposure side by open control from the measurement value of the focal position in the sample point of 3rd train 25C at the time of exposure is possible. On the other hand, there is un-arranging [that the calibration of the focal position in the sample point of 2nd train 25B and the focal position in the sample point of the 3rd train is required].
[0091] Moreover, by the full read-ahead controlling method, as shown in drawing 13 (a) - (d), more exact auto-focusing and auto leveling control are performed by changing the sample point of under an exposure start and exposure and the focal position just before an exposure end. That is, as shown in drawing 13 (a), when the shot field SA which should be exposed arrives at the position of an interval D (it is the same as the width of face of the direction of a scan of the exposure field 24) to the exposure field 24, measurement of the focal position by the multipoint focus position detection system is started in the sample field 42 of an interval D from the exposure field 24. An example of width of face D, i.e., the width of face of the direction of a scan of the exposure field 24, is 8mm. Then, as shown in drawing 13

(b), when the point of the shot field SA contacts the exposure field 24, leveling control of the direction of a scan is performed based on the measurement value of the focal position in the detection region 44 between two sample points on a wafer, and autofocus control is performed based on the measurement value of the focal position in the detection region 45 which consists of one sample point.
[0092] Next, as shown in drawing 13 (c), when the point of the shot field SA goes into the exposure field 24, leveling control of the direction of a scan is performed based on the measurement value of the focal position in the detection region 44 between two sample points on a wafer, and autofocus control is performed based on the measurement value of the focal position in the detection region 45 between two sample points. Moreover, as shown in drawing 13 (d), when the shot field SA comes to cover the exposure field 24, based on the measurement value of the focal position in the wrap detection region 44, leveling control of the direction of a scan is performed in the exposure field 24, and autofocus control is performed based on the measurement value of the focal position in the wrap detection region 45 in the exposure field 24.
[0093] On the other hand, also by the division read-ahead controlling method, as shown in drawing 13 (e) - (h), more exact auto-focusing and auto leveling control are performed by changing the sample point of under an exposure start and exposure and the focal position just before an exposure end. Namely, as shown in drawing 13 (e), when the shot field SA which should be exposed arrives at the position of interval D / 2 (1/2 of the width of face of the direction of a scan of the exposure field 24) to the exposure field 24, measurement of the focal position by the multipoint focus position detection system is started from the exposure field 24 by sample field 43B of interval D / 2 outside from sample field 43A of interval D / 2, and the exposure field 24 to the Then, as shown in drawing 13 (f), when the point of the shot field SA contacts the exposure field 24, based on the measurement value of the focal position in the wrap detection region 46, leveling control of the direction of a scan is performed in the exposure field 24, and autofocus control is performed based on the measurement value of the focal position in the detection region 47 which consists of one sample point.
[0094] Next, as shown in drawing 13 (g), when the point of the shot field SA enters in the exposure field 24 only in width-of-face D / 2, based on the measurement value of the focal position in the wrap detection region 46, leveling control of the direction of a scan is performed in the exposure field 24, and autofocus control is performed based on the measurement value of the focal position in the detection region 47 of width-of-face D / 2. Moreover, as shown in drawing 13 (h), when the shot field SA comes to cover the exposure field 24, based on the measurement value of the focal position in the wrap detection region 46, leveling control of the direction of a scan is performed in the exposure field 24, and autofocus control is performed based on the measurement value of the focal position in the wrap detection region 47 in the exposure field 24. Drawing 13 shows that run-up scan length (=D/2) is made to one half compared with the perfect predicting method by the division predicting method.
[0095] In addition, in the above-mentioned example, in order to measure the focal position of the multipoint of the exposure side of a wafer, the multipoint focus position detection system which projects on a wafer the opening pattern image of the shape of a slit arranged two-dimensional is used. However, the image of the pattern which is the shape of a slit long and slender in the direction of a non-scan may be projected on a wafer, and the 1-dimensional focal position detection system which measures the focal position of the whole direction of a non-scan may instead be used. Moreover, even when measuring the distribution of the two-dimensional focal position on the exposure side of a wafer using the focal position detection system of an image-processing method, highly precise focusing and highly precise leveling can be performed by applying the same division read ahead as the above-mentioned example etc. Furthermore, in this example, you may perform leveling operation of only the direction of a non-scan, without performing leveling operation of the direction of a scan to the leveling error of the direction of a non-scan, since the leveling error of the direction of a scan is small, so that drawing 17 may show.
[0096] In addition, of course, composition various in the range which this invention is not limited to the above-mentioned example, and does not deviate from the summary of this invention can be taken.
[0097]
[Effect of the Invention] According to the 1st field positioning equipment of this invention, in the projection aligner of a slit scan exposure method, the error by the irregularity of the front face of a sensitization substrate, the measurement precision of a multipoint measurement means, air fluctuation, etc. is amended, and there is an advantage with which the exposure side of a sensitization substrate can be doubled in parallel with high precision to the image surface of a projection optical system.
[0098] Moreover, when the sensitization substrate is scanned through the substrate side stage and a multipoint measurement means samples the height of the sensitization substrate in two or more measure points by the datum reference of a substrate side stage, the tilt angle of a scanning direction can be measured more to high degree of accuracy. Moreover, in measuring the height of the sensitization substrate in two or more measure points where a

multipoint measurement means consists of two or more points in the field of this side at the time of a sensitization substrate being scanned to the inside of two or more points in a conjugate exposure field, and the conjugate exposure field of those about the lighting field and the projection optical system of a predetermined configuration, respectively, there is an advantage which can shorten the run-up scan distance at the time of the start of exposure by division read-ahead control.

[0099] Moreover, when a multipoint measurement means changes the position of two or more measure points to one shot field of a sensitization substrate one by one in the process which exposes the pattern of a mask one by one, both leveling precision and a throughput can be improved by using together for example, a division read ahead and a full read ahead. Moreover, according to the 2nd field positioning equipment of this invention, in the projection aligner of a slit scan exposure method, the error by the irregularity of the front face of a sensitization substrate, the measurement precision of a multipoint measurement means, air fluctuation, etc. is amended, and there is an advantage with which the focal position of the exposure side of a sensitization substrate can be correctly doubled to the image surface of a projection optical system.

[Translation done.]

* NOTICES *

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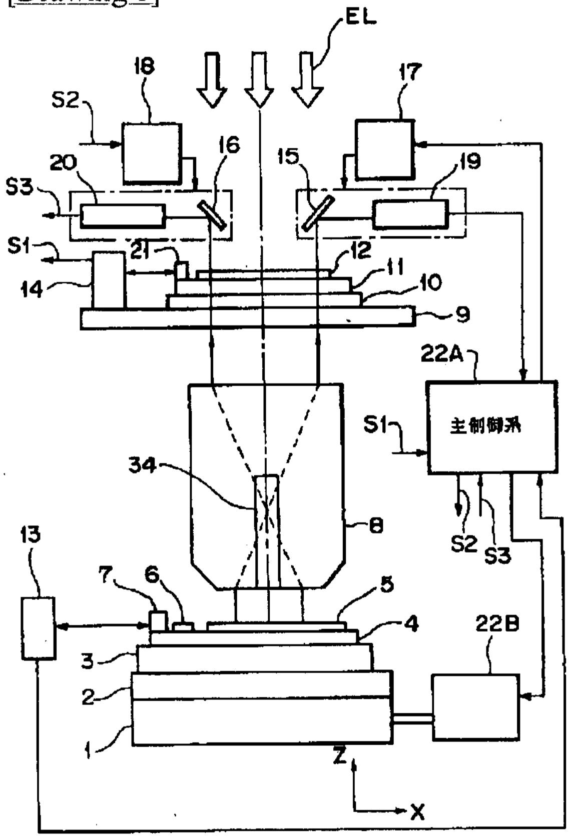
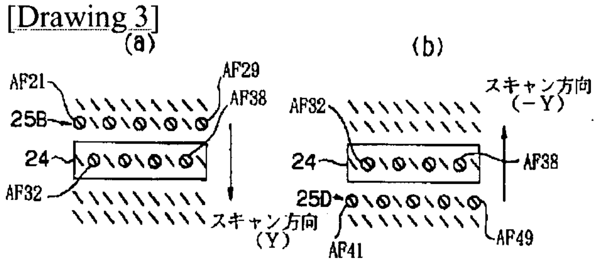
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

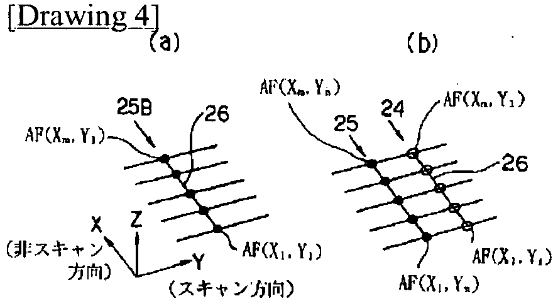
[Drawing 1]



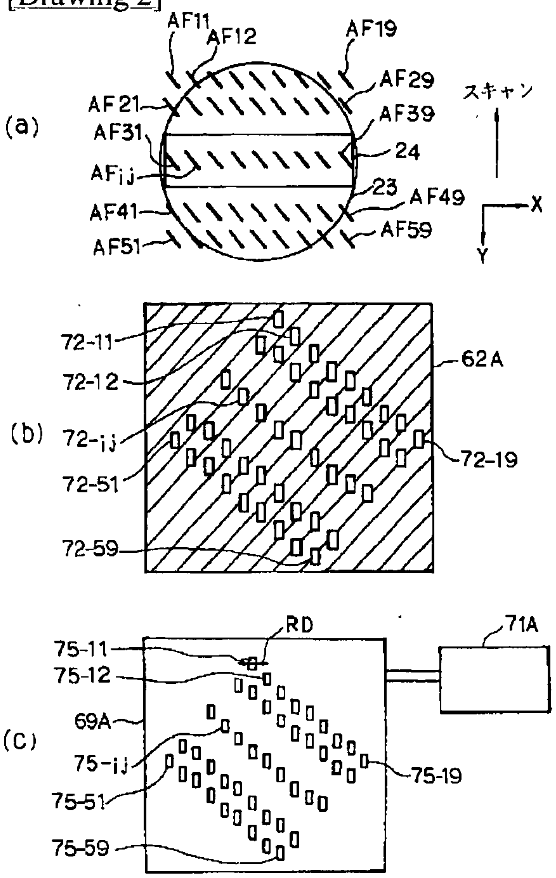
[Drawing 3]



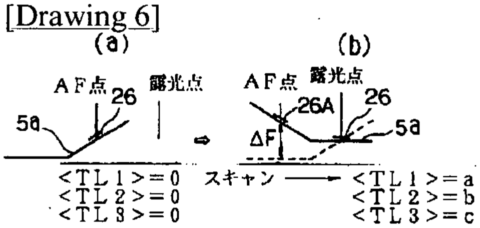
[Drawing 4]



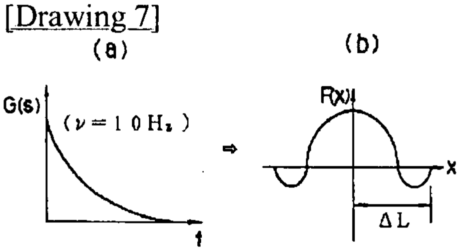
[Drawing 2]



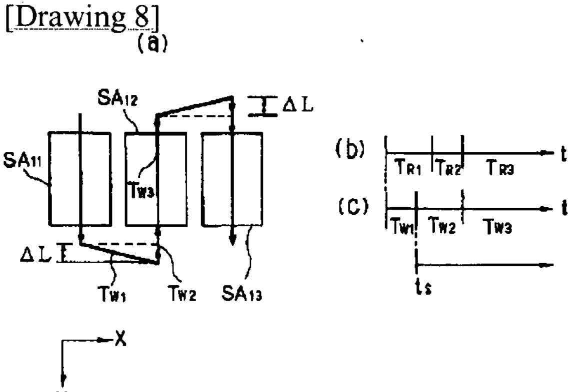
[Drawing 6]



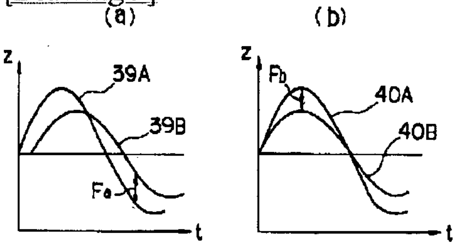
[Drawing 7]



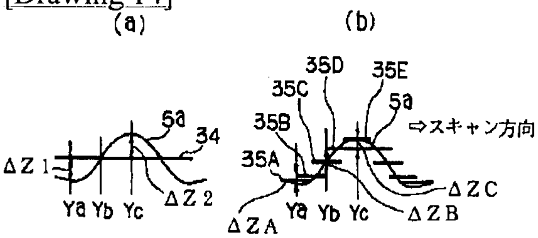
[Drawing 8]



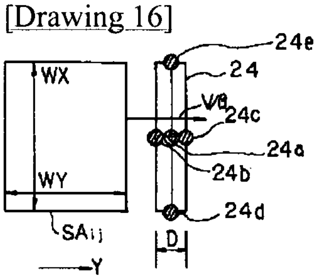
[Drawing 9]



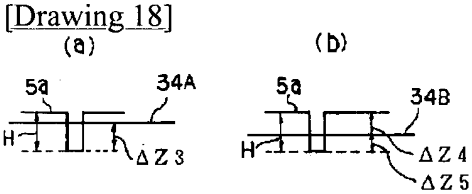
[Drawing 14]



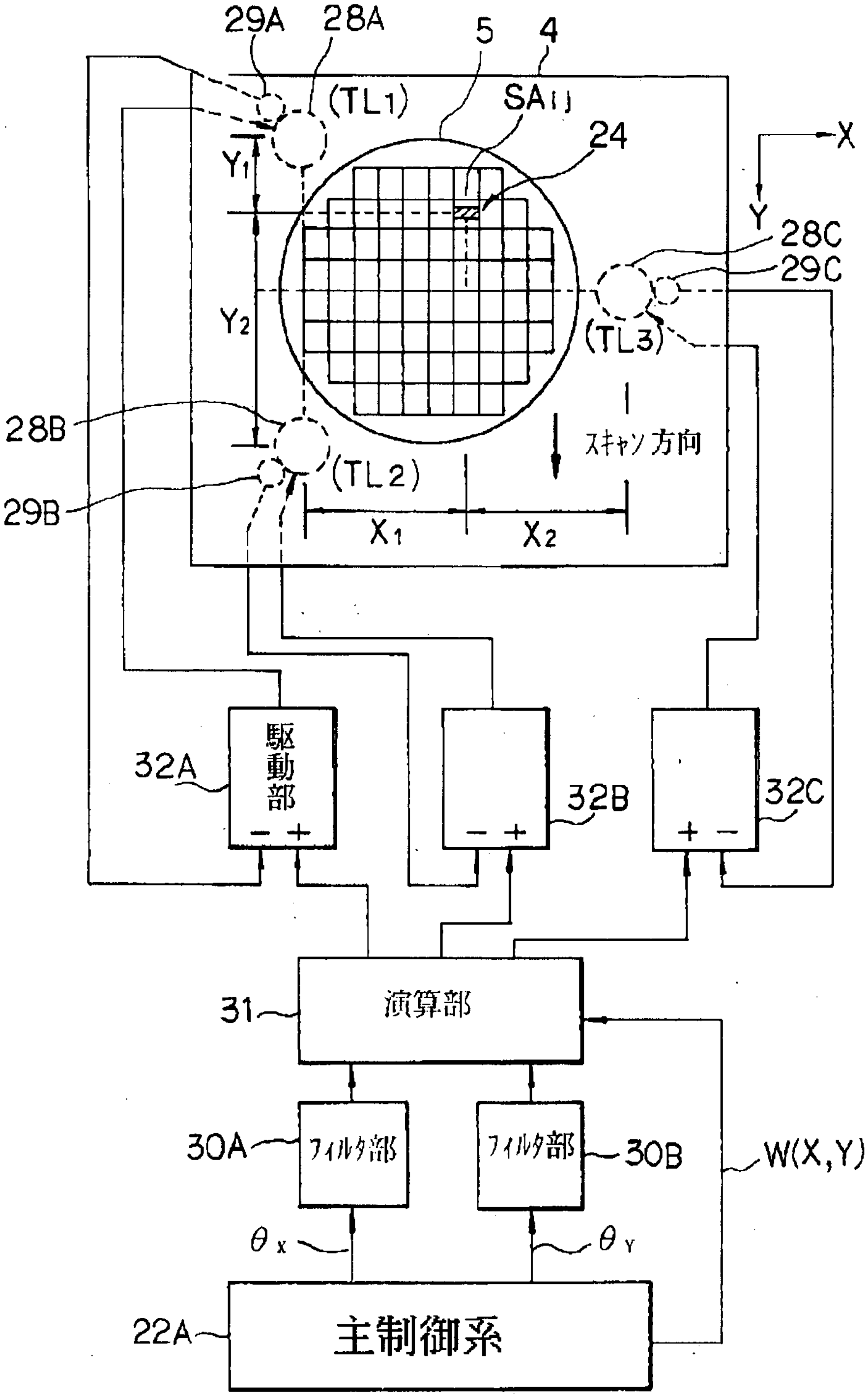
[Drawing 16]



[Drawing 18]



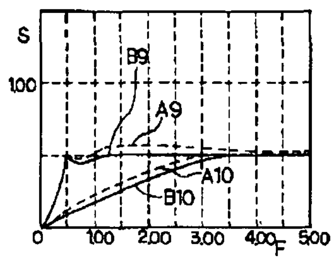
[Drawing 5]



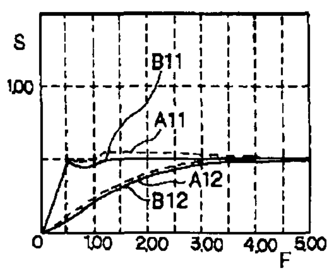
29A
28A
5
4
(TL1)
SAij
24
X
Y
Y1
Y2
28C
29C
(TL3)
28B
スキャン方向
(TL2)
29B
X1
X2
駆動部
32A
32B
32C
演算部
31
30A
フィルタ部
フィルタ部
30B
W(X,Y)
θx
θY
22A
主制御系

[Drawing 10]

(a)

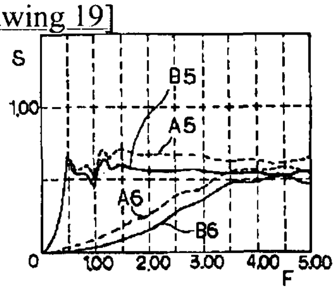


(b)

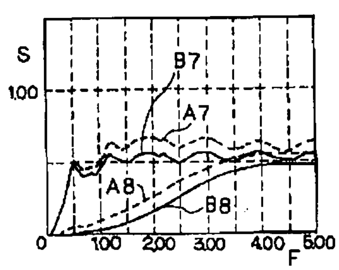


[Drawing 19]

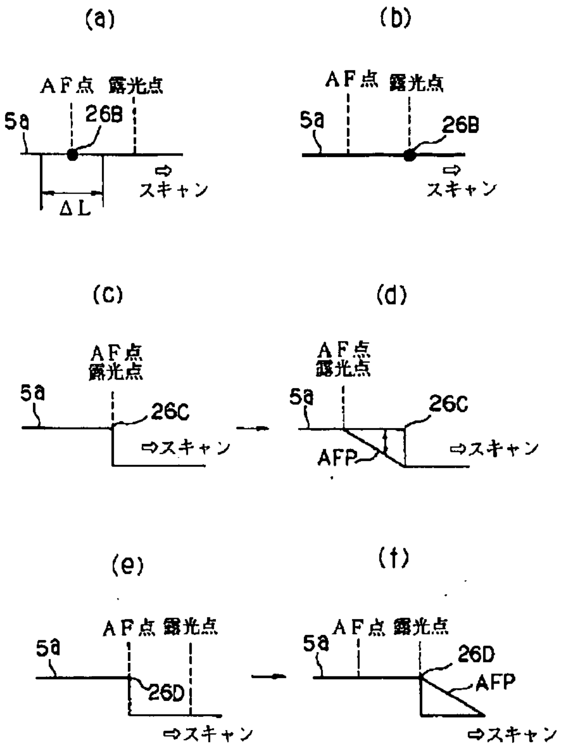
(a)



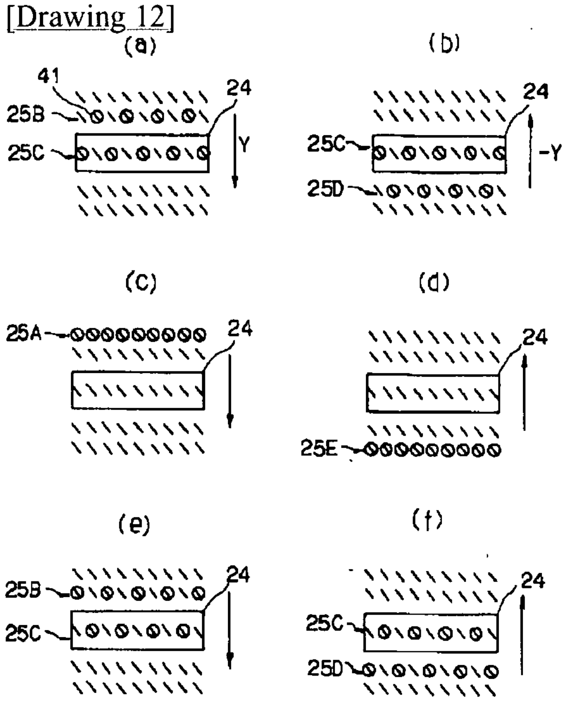
(b)



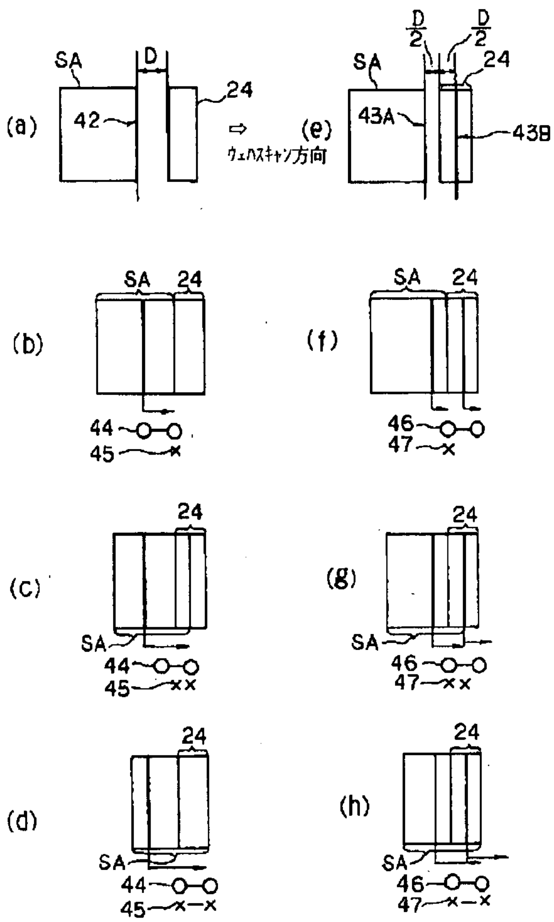
[Drawing 11]



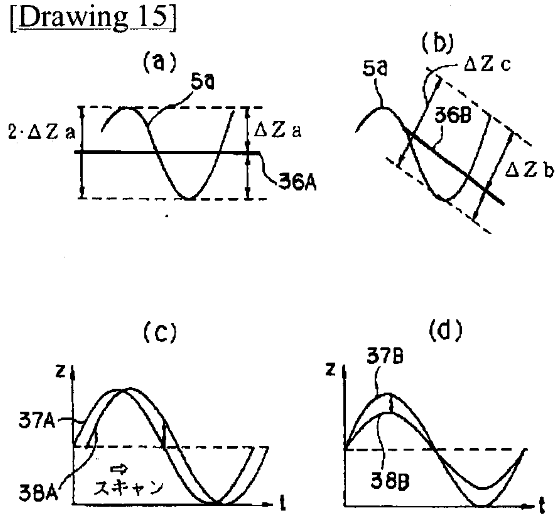
[Drawing 12]



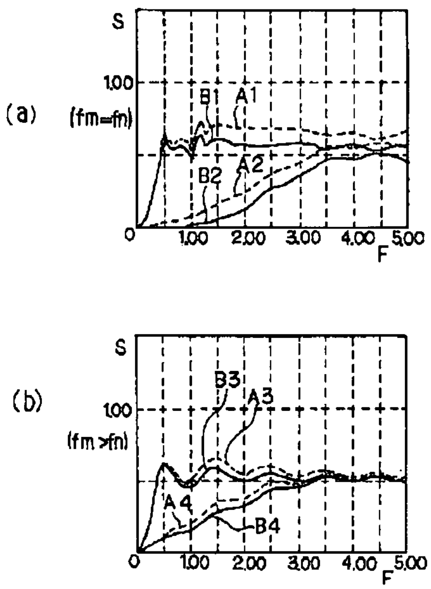
[Drawing 13]



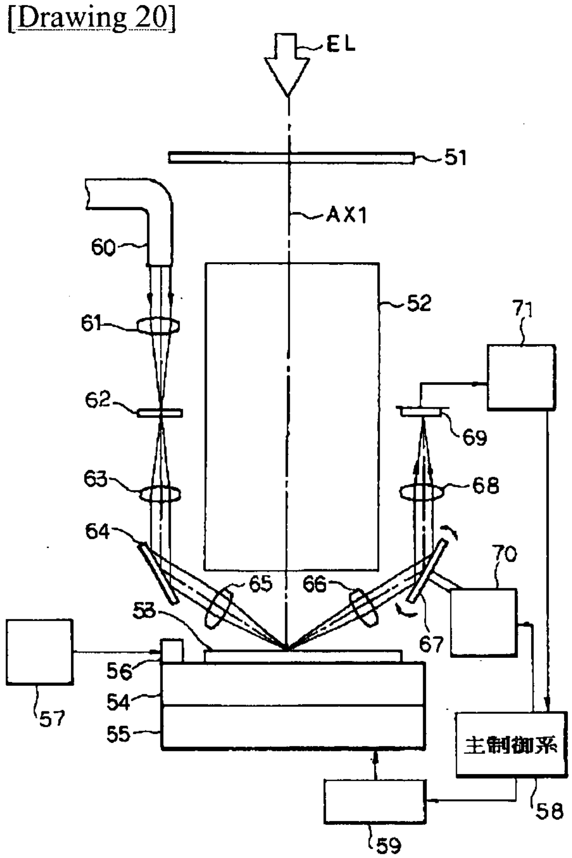
[Drawing 15]



[Drawing 17]

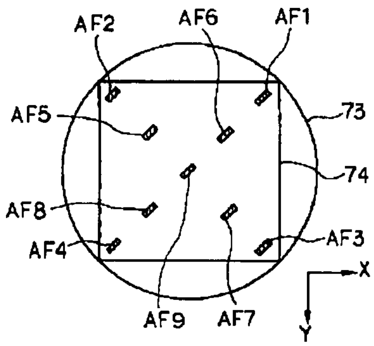


[Drawing 20]

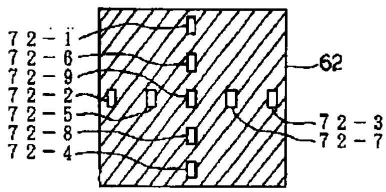


[Drawing 21]

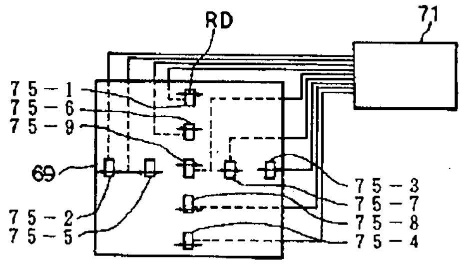
(a)



(b)



(c)



[Translation done.]

* NOTICES *

CORRECTION or AMENDMENT

[Official Gazette Type] Printing of amendment by the convention of 2 of Article 17 of patent law.
[Section partition] The 2nd partition of the 7th section.
[Date of issue] March 23, Heisei 13 (2001. 3.23)

[Publication No.] JP,6-283403,A.
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[**** format] Open patent official report 6-2835.
[Filing Number] Japanese Patent Application No. 5-67271.
[The 7th edition of International Patent Classification]

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H01L     21/027                .
G03B     27/32                 .
G03F      9/00                 .
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[FI]

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H01L     21/30      311 N          .
G03B     27/32          F          .
G03F      9/00          H          .
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[Procedure revision]
[Filing Date] June 14, Heisei 11 (1999. 6.14)
[Procedure amendment 1]
[Document to be Amended] Specification.
[Item(s) to be Amended] The name of invention.
[Method of Amendment] Change.
[Proposed Amendment]
[Title of the Invention] The scanning exposure method, field positioning equipment, a scanned type aligner, and the device manufacture method that uses the aforementioned method.
[Procedure amendment 2]
[Document to be Amended] Specification.
[Item(s) to be Amended] Claim.
[Method of Amendment] Change.
[Proposed Amendment]
[Claim(s)]
[Claim 1] The mask side stage which scans the lighting optical system which illuminates the lighting field of a predetermined configuration with exposure light, and the mask with which the pattern for exposure was formed to the aforementioned lighting field, The projection optical system which projects the pattern of the aforementioned mask in the aforementioned lighting field on a sensitization substrate, It is field positioning equipment for being prepared in the aligner which has the substrate side stage which scans the aforementioned sensitization substrate synchronizing with the aforementioned mask, and doubling the exposure side of the aforementioned sensitization substrate in parallel with the image surface of the aforementioned projection optical system.
A multipoint measurement means to measure the height of a direction parallel to the optical axis of the aforementioned projection optical system of the aforementioned sensitization substrate in two or more measure points including two or

more points of the direction which crosses in the direction in which the aforementioned sensitization substrate is scanned, respectively,

An operation means to ask for the difference of the tilt angle between the exposure side of the aforementioned sensitization substrate, and the image surface of the aforementioned projection optical system from the measurement result of this multipoint measurement means,

It is prepared in the aforementioned substrate side stage, and has the inclination setting stage which sets up the tilt angle of the direction which intersects perpendicularly in the tilt angle of the direction of the aforementioned scan of the aforementioned sensitization substrate, and the direction of the aforementioned scan based on the difference of the aforementioned tilt angle called for by the aforementioned operation means.

Field positioning equipment characterized by making a speed of response in case this inclination setting stage sets up the tilt angle of the direction of the aforementioned scan of the aforementioned sensitization substrate differ from the speed of response when setting up the tilt angle of the direction which intersects perpendicularly towards the aforementioned scan.

[Claim 2] The aforementioned multipoint measurement means is field positioning equipment according to claim 1 characterized by sampling the height of the aforementioned sensitization substrate in the measure point of the aforementioned plurality in the datum reference of the aforementioned substrate side stage when the aforementioned sensitization substrate is scanned through the aforementioned substrate side stage.

[Claim 3] the aforementioned multipoint measurement means -- the lighting field and the aforementioned projection optical system of the aforementioned predetermined configuration -- being related -- two or more points in a conjugate exposure field, and the above -- the field positioning equipment according to claim 1 or 2 characterized by to measure the height of the aforementioned sensitization substrate, respectively in two or more measure points which consist of two or more points in the field of this side at the time of the aforementioned sensitization substrate being scanned to the inside of a conjugate exposure field

[Claim 4] The aforementioned multipoint measurement means is field positioning equipment according to claim 1 characterized by changing the position of two or more aforementioned measure points to one shot field of the aforementioned sensitization substrate one by one in the process which exposes the pattern of the aforementioned mask one by one.

[Claim 5] The mask side stage which scans the lighting optical system which illuminates the lighting field of a predetermined configuration with exposure light, and the mask with which the pattern for exposure was formed to the aforementioned lighting field, The projection optical system which projects the pattern of the aforementioned mask in the aforementioned lighting field on a sensitization substrate, It is field positioning equipment for being prepared in the aligner which has the substrate side stage which scans the aforementioned sensitization substrate synchronizing with the aforementioned mask, and doubling the height of the exposure side of the aforementioned sensitization substrate with the image surface of the aforementioned projection optical system.

A height measurement means to measure the height of a direction parallel to the optical axis of the aforementioned projection optical system of the aforementioned sensitization substrate in the predetermined measure point in the measurement field which consists of a field of this side at the time of the aforementioned sensitization substrate being scanned to a conjugate exposure field and this exposure field about the lighting field and the aforementioned projection optical system of the aforementioned predetermined configuration,

An operation means to ask for the difference of the average height of the exposure side of the aforementioned sensitization substrate, and the height of the image surface of the aforementioned projection optical system based on the maximum and the minimum value of two or more height measurement results obtained by the aforementioned height measurement means when the aforementioned sensitization substrate is scanned,

Field positioning equipment characterized by having the height setting stage which sets up the height of the aforementioned sensitization substrate based on the difference of the aforementioned height which was prepared in the aforementioned substrate side stage and found by the aforementioned operation means.

[Claim 6] In the scanned type aligner which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam

A detection means to detect the positional information of the 2nd body of the above about the direction of an optical axis of the aforementioned projection system in two or more measure points during movement of the 2nd body of the above,

It has a setting means to set up the inclination of the 2nd body of the above during movement of the 2nd body of the above based on the detection result of the aforementioned detection means.

This setting means is a scanned type aligner characterized by changing the speed of response when setting up the

inclination of the speed of response when setting up the inclination of the move direction of the 2nd body of the above, the move direction of the 2nd body of the above, and the crossing direction.
[Claim 7] In the scanned type aligner which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam
A detection means to detect the positional information of the 2nd body of the above about the direction of an optical axis of the aforementioned projection system in two or more measure points during movement of the 2nd body of the above,
An adjustment means to adjust the physical relationship of the image surface of the aforementioned projection system, and the 2nd body of the above during movement of the 2nd body of the above based on the maximum of the positional information detected at two or more detecting points of the aforementioned detection means, and the minimum value,
The scanned type aligner characterized by ************.
[Claim 8] The aforementioned adjustment means is a scanned type aligner according to claim 7 characterized by performing weighting to the aforementioned maximum and the aforementioned minimum value, and making substantially the field of the request on the 2nd body of the above in agreement with the image surface of the aforementioned projection system.
[Claim 9] The aforementioned adjustment means is a scanned type aligner according to claim 7 or 8 characterized by adjusting the inclination relation between the image surface of the aforementioned projection system, and the 2nd body of the above about the move direction of the 2nd body of the above, and the crossing direction.
[Claim 10] In the scanned type aligner which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam
A detection means to detect the positional information of the 2nd body of the above about the direction of an optical axis of the aforementioned projection system in two or more detecting points during movement of the 2nd body of the above,
An alignment means to perform weighting to the positional information detected at two or more detecting points of the aforementioned detection means, and to perform alignment of the field of the request on the 2nd body of the above, and the image surface of the aforementioned projection system during movement of the 2nd body of the above,
The scanned type aligner characterized by ************.
[Claim 11] The aforementioned alignment means is a scanned type aligner according to claim 10 characterized by adjusting the inclination relation between the request side on the 2nd body of the above, and the image surface of the aforementioned projection system about the move direction of the 2nd body of the above, and the crossing direction.
[Claim 12] The aforementioned alignment means is a scanned type aligner according to claim 10 or 11 characterized by having the supporting point which can move independently, respectively, adjusting the movement magnitude of this supporting point, respectively, and performing alignment of the image surface of the aforementioned projection system, and the field of the request on the 2nd body of the above while supporting the 2nd body of the above.
[Claim 13] In the scanned type aligner which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam
A detection means to detect the positional information of the 2nd body of the above about the direction of an optical axis of the aforementioned projection system at two or more detecting points during movement of the 2nd body of the above,
It has a setting means to perform a field setup of the 2nd body of the above to the image surface of the aforementioned projection system during movement of the 2nd body of the above based on the detection result of the aforementioned detection means.
The scanned type aligner characterized by changing the speed of response when performing a field setup of the 2nd body of the above according to the traverse speed of the 2nd body of the above.
[Claim 14] The aforementioned speed of response is a scanned type aligner according to claim 13 characterized by being managed with a filter.
[Claim 15] Change of the aforementioned speed of response is a scanned type aligner according to claim 13 characterized by including change of the servo gain of the mechanical component of the aforementioned setting means.

[Claim 16] The aforementioned detection means is a scanned type aligner given in any 1 term of the claims 6-15 characterized by having a detecting point in the irradiation field of the exposure beam which passed the aforementioned projection system.

[Claim 17] The aforementioned detection means is a scanned type aligner given in any 1 term of the claims 6-15 characterized by having the detecting point which is distant from the irradiation field of the exposure beam which passed the aforementioned projection system.
[Claim 18] Two or more aforementioned detecting points are scanned type aligners given in any 1 term of the claims 6-17 characterized by being separated and set up in the move direction of the 2nd body of the above, and the crossing direction.
[Claim 19] Two or more aforementioned detecting points are scanned type aligners according to claim 18 characterized by 2-dimensional the thing arranged-like.
[Claim 20] In the scanned type aligner which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam
A detection means to detect the concavo-convex information on the exposure side of the 2nd body of the above,
In order to perform alignment of the exposure side of the 2nd body of the above, and the image surface of the aforementioned projection system during scanning exposure of the exposure side of the 2nd body of the above, it has a setting means to perform a field setup of the aforementioned exposure side based on the concavo-convex information detected with the aforementioned detection means.
This setting means is a scanned type aligner characterized by suppressing a field setup which worsens the alignment precision of the aforementioned image surface and the aforementioned exposure side.
[Claim 21] The scanned type aligner according to claim 20 characterized by detecting the concavo-convex information on the exposure side of the 2nd body of the above by the aforementioned detection means, moving the 2nd body of the above in advance of scanning exposure of the 2nd body of the above in order to suppress the aforementioned field setup.
[Claim 22] The aforementioned detection means is a scanned type aligner according to claim 20 or 21 characterized by detecting the aforementioned concavo-convex information, when the positional information of the exposure side of the 2nd body of the above about the direction of an optical axis of the aforementioned projection system measures during movement of the 2nd body of the above in two or more measure points.
[Claim 23] The aforementioned setting means is a scanned type aligner given in any 1 term of the claims 20-22 characterized by having a suppression means for suppressing the aforementioned field setup.
[Claim 24] The aforementioned suppression means is a scanned type aligner according to claim 23 characterized by suppressing the aforementioned field setup by carrying out filtering processing of the information detected with the aforementioned detection means.
[Claim 25] The aforementioned setting means is a scanned type aligner given in any 1 term of the claims 20-23 characterized by suppressing the aforementioned field setup by having a mechanical component for moving the supporting point of the 2nd body of the above in the direction of an optical axis of the aforementioned projection system, and adjusting the servo gain of this mechanical component.
[Claim 26] The aforementioned servo gain is a scanned type aligner according to claim 25 characterized by being adjustable according to the traverse speed of the 2nd body of the above.
[Claim 27] The aforementioned setting means is a scanned type aligner given in any 1 term of the claims 20-26 characterized by suppressing a setup of the inclination of the exposure side of the 2nd body of the above.
[Claim 28] The device manufacture method using a scanned type aligner given in any 1 term of claims 6-27.
[Claim 29] In the scanning exposure method which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam
The scanning exposure method characterized by changing the speed of response when setting up the inclination of the speed of response when setting up the inclination of the move direction of the 2nd body of the above, the move direction of the 2nd body of the above, and the crossing direction in case the inclination of the 2nd body of the above is set up during movement of the 2nd body of the above.
[Claim 30] In the scanning exposure method which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam
The scanning exposure method characterized by changing the speed of response when setting up the inclination of the move direction of the 2nd body of the above according to the traverse speed of the 2nd body of the above in case the inclination of the 2nd body of the above is set up during movement of the 2nd body of the above.
[Claim 31] In the scanning exposure method which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st

body to an exposure beam
The scanning exposure method characterized by adjusting the physical relationship of the image surface of the aforementioned projection system, and the 2nd body of the above based on the maximum of the positional information detected at two or more of these detecting points, and the minimum value while detecting the positional information of the 2nd body of the above about the direction of an optical axis of the aforementioned projection system in two or more measure points during movement of the 2nd body of the above.
[Claim 32] In the scanning exposure method which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam
The scanning exposure method which performs weighting to the positional information which detects the positional information of the 2nd body of the above about the direction of an optical axis of the aforementioned projection system in two or more detecting points, and is detected at two or more of these detecting points during movement of the 2nd body of the above, and is characterized by the thing of the field of the request on the 2nd body of the above, and the image surface of the aforementioned projection system to do for alignment.
[Claim 33] Two or more aforementioned detecting points are the scanning exposure methods according to claim 31 or 32 characterized by including the detecting point in the irradiation field of the exposure beam which passed the aforementioned projection system.
[Claim 34] Two or more aforementioned detecting points are the scanning exposure methods given in any 1 term of the claims 31-33 characterized by including the detecting point which is distant from the irradiation field of the exposure beam which passed the aforementioned projection system.
[Claim 35] Two or more aforementioned detecting points are the scanning exposure methods according to claim 33 or 34 characterized by including two or more detecting points which separated in the move direction of the 2nd body of the above, and the crossing direction.
[Claim 36] In the scanning exposure scanning exposure method which carries out scanning exposure of the 2nd body of the above by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam
The scanning exposure method of carrying out suppressing a field setup which worsens the alignment precision of the aforementioned image surface and the aforementioned exposure side when carrying out scanning exposure in the aforementioned exposure side, performing a field setup of the aforementioned exposure side based on the concavo-convex information on the aforementioned exposure side in order to perform alignment of the exposure side of the 2nd body of the above, and the image surface of the aforementioned projection system as the feature.
[Claim 37] The scanning exposure method according to claim 36 characterized by detecting the concavo-convex information on the exposure side of the 2nd body of the above, moving the 2nd body of the above in advance of scanning exposure of the 2nd body of the above in order to suppress the aforementioned field setup.
[Claim 38] The aforementioned concavo-convex information is the scanning exposure method according to claim 37 characterized by asking when the positional information of the exposure side of the 2nd body of the above about the direction of an optical axis of the aforementioned projection system detects in two or more measure points, moving the 2nd body of the above.
[Claim 39] Suppression of the aforementioned field setup is the scanning exposure method given in any 1 term of the claims 36-38 characterized by including suppression of an inclination setup of the exposure side of the 2nd body of the above.
[Claim 40] The device manufacture method using the scanning exposure method given in any 1 term of claims 29-39.
[Procedure amendment 3]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0001.
[Method of Amendment] Change.
[Proposed Amendment]
[0001]
[Industrial Application] this invention is used for the projection aligner of the slit scan exposure method equipped with the autofocus mechanism or the auto leveling mechanism, and relates to the suitable scanning exposure method. Furthermore, this invention relates to the device manufacture method which uses the field positioning equipment which can be used in case such a scanning exposure method is enforced, a scanned type aligner, and its scanning exposure method.
[Procedure amendment 4]
[Document to be Amended] Specification.

[Item(s) to be Amended] 0014.
[Method of Amendment] Change.
[Proposed Amendment]
[0014] this invention aims at offering the scanning exposure method which can be used in the projection aligner of a slit scan exposure method in order to double the exposure side of a sensitization substrate with high precision to the image surface of a projection optical system in view of this point. Furthermore, this invention aims also at offering the device manufacture method that a device can be manufactured with high precision using the field positioning equipment which can be used in case the scanning exposure method is enforced, a scanned type aligner, and its scanning exposure method.
[Procedure amendment 5]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0018.
[Method of Amendment] Change.
[Proposed Amendment]
[0018] Moreover, as for the multipoint measurement means, it is desirable to change the position of the measure point of these plurality to one shot field of a sensitization substrate (5) one by one in the process which exposes the pattern of a mask (12) one by one. Moreover, the 2nd field positioning equipment by this invention The lighting optical system which illuminates the lighting field of a predetermined configuration with exposure light, and the mask side stage which scans the mask (12) in which the pattern for exposure was formed to the lighting field (10), The projection optical system which projects the pattern of the mask in the lighting field (12) on a sensitization substrate (5) (8), It is prepared in the aligner which has the substrate side stage (2) which scans a sensitization substrate (5) synchronizing with a mask (12). It is field positioning equipment for doubling the height of the exposure side of a sensitization substrate (5) with the image surface of a projection optical system (8). In the predetermined measure point in the measurement field which consists of a field of this side at the time of a sensitization substrate (5) being scanned to a conjugate exposure field (24) and this exposure field about the lighting field and projection optical system (8) of the predetermined configuration A height measurement means to measure the height of a direction parallel to the optical axis of the projection optical system (8) of a sensitization substrate (5) (62A, 69A), The inside of two or more height measurement results obtained by the height measurement means when a sensitization substrate (5) is scanned, An operation means to ask for the difference of the average height of the exposure side of a sensitization substrate (5), and the height of the image surface of a projection optical system (8) based on maximum and the minimum value (71A), It is prepared in a substrate side stage (2), and has the height setting stage (4) which sets up the height of a sensitization substrate (5) based on the difference of the height found by the operation means (71A). Next, the 1st scanned type aligner by this invention By moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam A detection means to detect the positional information of the 2nd body about the direction of an optical axis of the projection system in two or more measure points during movement of the 2nd body in the scanned type aligner which carries out scanning exposure of the 2nd body, It has a setting means to set up the inclination of the 2nd body during movement of the 2nd body based on the detection result of the detection means. this setting means The speed of response when setting up the inclination of the speed of response and the move direction of the 2nd body of [when setting up the inclination of the move direction of the 2nd body], and the crossing direction is changed. Moreover, the 2nd scanned type aligner by this invention By moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam A detection means to detect the positional information of the 2nd body about the direction of an optical axis of the projection system in two or more measure points during movement of the 2nd body in the scanned type aligner which carries out scanning exposure of the 2nd body, It has an adjustment means to adjust the physical relationship of the image surface and the 2nd body of the projection system during movement of the 2nd body based on the maximum of the positional information detected at two or more detecting points of the detection means, and the minimum value. Moreover, the 3rd scanned type aligner by this invention By moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam A detection means to detect the positional information of the 2nd body about the direction of an optical axis of the projection system in two or more detecting points during movement of the 2nd body in the scanned type aligner which carries out scanning exposure of the 2nd body, It has an alignment means to perform weighting to the positional information detected at two or more detecting points of the detection means, and to perform alignment of the field and the image surface of a projection system of the request on the 2nd body during movement of the 2nd body. Moreover, the 4th scanned type aligner by this invention By moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam A detection means to detect the positional

information of the 2nd body about the direction of an optical axis of the projection system at two or more detecting points during movement of the 2nd body in the scanned type aligner which carries out scanning exposure of the 2nd body, During movement of the 2nd body, it has a setting means to perform a field setup of the 2nd body to the image surface of the projection system based on the detection result of the detection means, and the speed of response when performing a field setup of the 2nd body is changed according to the traverse speed of the 2nd body. Moreover, the 5th scanned type aligner by this invention By moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam A detection means to detect the concavo-convex information on the exposure side of the 2nd body in the scanned type aligner which carries out scanning exposure of the 2nd body, It has a setting means to perform a field setup of the exposure side based on the concavo-convex information detected with the detection means in order to perform alignment of the exposure side and the image surface of a projection system of the 2nd body during scanning exposure of the exposure side of the 2nd body. This setting means suppresses a field setup which worsens the alignment precision of the image surface and its exposure side. The 1st scanning exposure method by this invention next, by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam When the inclination of the 2nd body is set up during movement of the 2nd body in the scanning exposure method which carries out scanning exposure of the 2nd body, The speed of response when setting up the inclination of the speed of response and the move direction of the 2nd body of [when setting up the inclination of the move direction of the 2nd body], and the crossing direction is changed. The 2nd scanning exposure method by this invention moreover, by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam In the scanning exposure method which carries out scanning exposure of the 2nd body, in case the inclination of the 2nd body is set up during movement of the 2nd body, the speed of response when setting up the inclination of the move direction of the 2nd body is changed according to the traverse speed of the 2nd body. The 3rd scanning exposure method by this invention moreover, by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam In the scanning exposure method which carries out scanning exposure of the 2nd body, while detecting the positional information of the 2nd body about the direction of an optical axis of the projection system in two or more measure points during movement of the 2nd body Based on the maximum of the positional information detected at two or more of these detecting points, and the minimum value, the physical relationship of the image surface and the 2nd body of the projection system is adjusted. The 4th scanning exposure method by this invention moreover, by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam In the scanning exposure method which carries out scanning exposure of the 2nd body during movement of the 2nd body Weighting is performed to the positional information which detects the positional information of the 2nd body about the direction of an optical axis of the projection system in two or more detecting points, and is detected at two or more of these detecting points, and it is the thing of the field and the image surface of a projection system of the request on the 2nd body which carries out alignment. The 5th scanning exposure method by this invention moreover, by moving the 2nd body to the exposure beam which passed the projection system synchronizing with moving the 1st body to an exposure beam When carrying out scanning exposure of the exposure side, performing a field setup of the exposure side based on the concavo-convex information on the exposure side in the scanning exposure scanning exposure method which carries out scanning exposure of the 2nd body in order to perform alignment of the exposure side and the image surface of a projection system of the 2nd body A field setup which worsens the alignment precision of the image surface and its exposure side is suppressed. Next, the scanned type aligner of the above-mentioned this invention is used for the 1st device manufacture method by this invention. Moreover, the scanning exposure method of the above-mentioned this invention is used for the 2nd device manufacture method by this invention.

[Procedure amendment 6]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0019.
[Method of Amendment] Change.
[Proposed Amendment]
[0019]
[Function] In this this invention, in case the mask (12) as the 1st body and the sensitization substrate (5) as the 2nd body are scanned synchronously and the pattern image of a mask (12) is exposed on a sensitization substrate (5), the height of a sensitization substrate (5) is measured in two or more measure points including the measure point before the direction of the scan using the multipoint measurement means. And it asks for the tilt angle of a sensitization substrate (5) by acquiring multiple-times height information along the direction of a scan in the measure point of these plurality, respectively. Then, in case the pattern image of a mask (12) is exposed to the field to which the tilt angle was called for

such, the tilt angle of the field is set up based on the tilt angle for which it asked beforehand. Thereby, the exposure side of a sensitization substrate (5) is set up in parallel with the image surface of a projection optical system (8) also by the slit scan exposure method.

[Procedure amendment 7]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0027.
[Method of Amendment] Change.
[Proposed Amendment]

[0027] In this invention, in order to remove these errors, the responsibility of the direction of a scan of a leveling mechanism and the responsibility of the direction of a non-scan are changed. It is premised on the focal position detection system of an oblique incidence type multipoint as a multipoint measurement means for auto leveling mechanisms in this invention. Moreover, it aims at making maximum of the gap with each point of the exposure side in the predetermined field, and the image surface of a projection optical system into the minimum regardless of the average field of the exposure side of the sensitization substrate in the predetermined field in the exposure field of a projection optical system. Thus, in the predetermined field in the exposure field of a projection optical system, the exposure field in case the maximum of the gap with almost all the points of the exposure side of a sensitization substrate and the image surface of a projection optical system is the minimum is called "good field (Good Field)."

[Procedure amendment 8]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0035.
[Method of Amendment] Change.
[Proposed Amendment]

[0035] Next, the autofocus control in this invention is considered. If the concept of the above-mentioned good field (Good Field) is taken in, as shown in drawing 16, precision may get worse by performing equalization processing of the focal position of each measure point in center-section 24a of the exposure field 24, and doubling with the image surface of a projection optical system the field shown by the average of the focal position. That is, drawing 18 (a) shows field 34A corresponding to the average of the focal position of each measure point of exposure side 5a with the crevice of depth H of a sensitization substrate, and the difference deltaZ3 of the direction of a focus of the field 34A and crevice is large from H/2.

[Procedure amendment 9]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0097.
[Method of Amendment] Change.
[Proposed Amendment]
[0097]

[Effect of the Invention] According to the 1st field positioning equipment of this invention, the 1st scanned type aligner, the 1st scanning exposure method, etc., in the projection aligner of a slit scan exposure method, the error by the irregularity of the front face of a sensitization substrate, the measurement precision of a multipoint measurement means, air fluctuation, etc. is amended, and there is an advantage with which the exposure side of a sensitization substrate can be doubled in parallel with high precision to the image surface of a projection optical system.

[Procedure amendment 10]
[Document to be Amended] Specification.
[Item(s) to be Amended] 0099.
[Method of Amendment] Change.
[Proposed Amendment]

[0099] Moreover, when a multipoint measurement means changes the position of two or more measure points to one shot field of a sensitization substrate one by one in the process which exposes the pattern of a mask one by one, both leveling precision and a throughput can be improved by using together for example, a division read ahead and a full read ahead. Moreover, according to the 2nd field positioning equipment of this invention, the 2nd scanned type aligner, the 3rd scanning exposure method, etc., in the projection aligner of a slit scan exposure method, the error by the irregularity of the front face of a sensitization substrate, the measurement precision of a multipoint measurement means, air fluctuation, etc. is amended, and there is an advantage with which the focal position of the exposure side of a sensitization substrate can be correctly doubled to the image surface of a projection optical system.

[Procedure amendment 11]
[Document to be Amended] Specification.

[Item(s) to be Amended] Drawing 1.
[Method of Amendment] Change.
[Proposed Amendment]
[Drawing 1] It is the block diagram showing the projection aligner of one example of this invention.

[Translation done.]